ANNALS OF THE ROYAL COLLEGE OF SURGEONS OF ENGLAND

VOLUME 27 NOVEMBER 1960 No. 5

Polybactrin

antibiotic powder spray

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The use of Polybactrin during surgical procedures is a positive method of inhibiting wound pathogens which may become implanted in the tissues.

INDICATIONS : General surgery — gynaecological operations — orthopaedic surgery — Burns etc.

FORMULA : Powder content 1.5 g.
Each gramme contains :

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Polymyxin B Sulphate	100,000 units
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Pressurised with :
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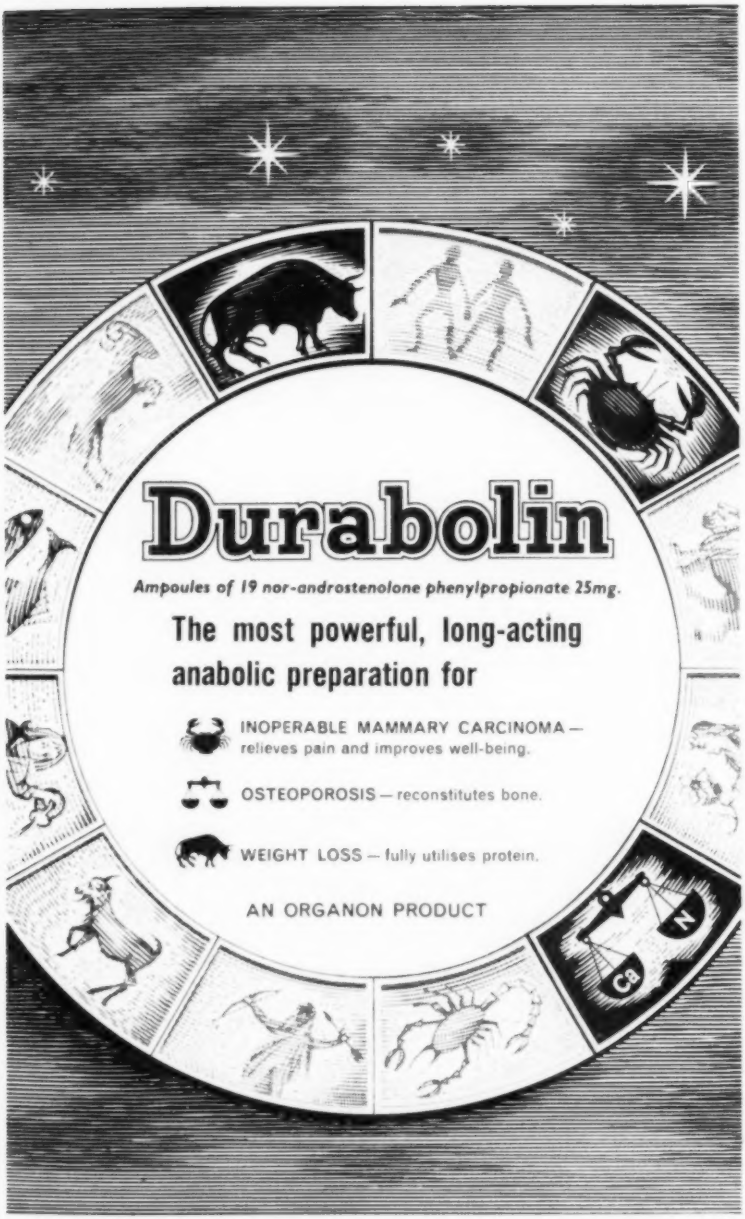
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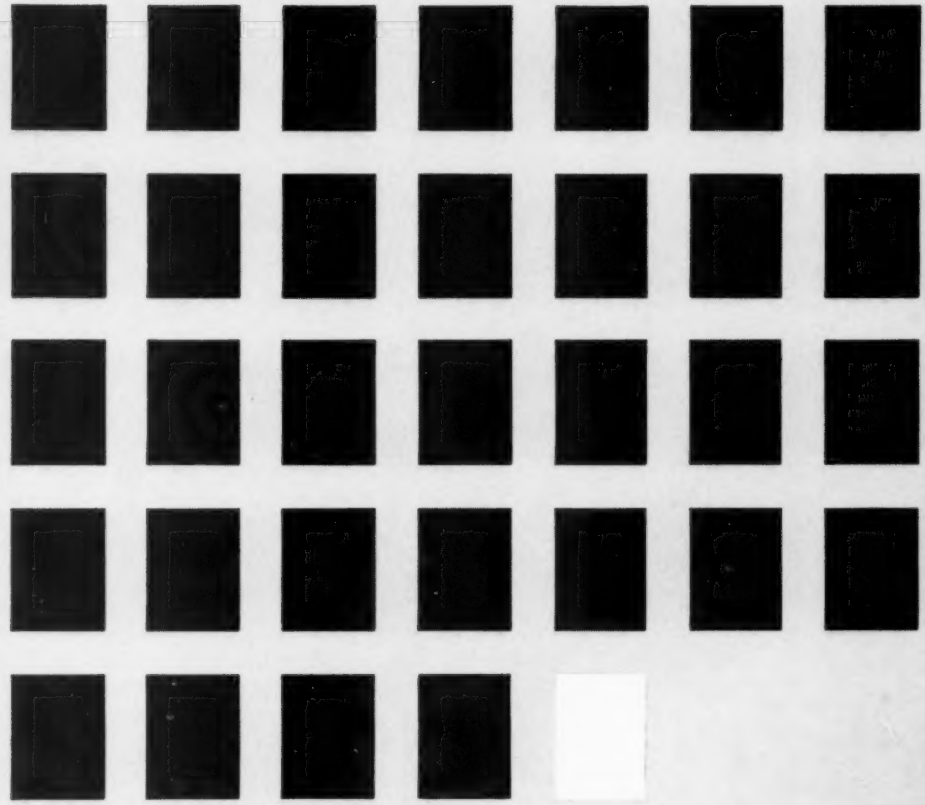

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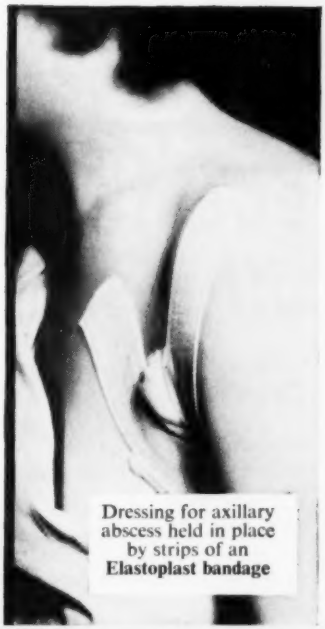

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ANNALS
OF THE
ROYAL COLLEGE OF SURGEONS OF ENGLAND

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Volume 27 NOVEMBER 1960 No. 5

Published by
THE ROYAL COLLEGE OF SURGEONS OF ENGLAND
LINCOLN'S INN FIELDS LONDON, W.C.2

Annual Subscription - *£2 post free*
Single copies - - *3s. 6d. post free*

ANNALS OF
THE ROYAL COLLEGE OF SURGEONS OF ENGLAND

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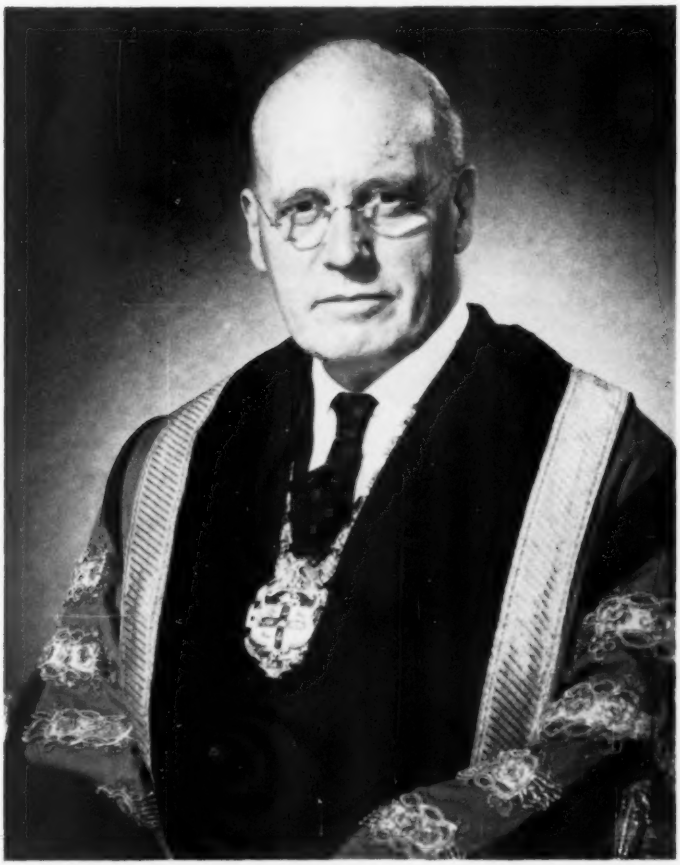
NOVEMBER 1960

Telegrams : Collsurg, Holb, London
Cables : Collsurg, London Telephone : Holborn 3474

SIR JAMES PATERSON ROSS, Bt.
K.C.V.O., LL.D. (Hon. Causa), M.S., F.R.C.S.

On 14th July last Sir James Paterson Ross vacated the Presidential Chair of the Royal College of Surgeons of England, which he had occupied during three momentous years.

On 30th September he automatically retired, on the age limit, from his appointment, which he had held since 1935, as Professor of Surgery in



Sir James Paterson Ross, Bt.

the University of London and Director of the whole-time Professorial Clinical Surgical Unit at St. Bartholomew's Hospital. It has been by his integrity, abnegation of self and tactful approach to many problems in all these appointments that he has been able to achieve so much to establish and further the ambitious projects of the Council and the three previous Presidents to reconstruct the College in such a way as to enable it to take its rightful place as a vital centre of surgical research. However, his work in the development of post-graduate education in the United Kingdom will be continued as the Authorities of the University of London have appointed him to succeed Sir Francis Fraser on 1st October as the Director of the British Post-graduate Medical Federation.

Post-graduate education

"Medicine is the only profession which shows any concern for the further education for its graduates. Upon a given day the graduate may profess that he has acquired the mystery but no one believes him. There is a great gulf fixed between knowing a thing and professing to know it; and a still wider one between the knowing and doing of it. The study of medicine must continue as long as life endures."

The event of death cannot be avoided, but invalidity and premature death in many cases can be prevented and to accomplish this ideal the graduate should not be content with looking over the shoulder of another but must work with his own hands and use his own observation.

Post-graduate teaching becomes each day more necessary owing to the overcrowded state of the undergraduate curriculum, the advance of medical knowledge and the ever-increasing sphere of medicine in relation to the State.

Before the 1914–1918 war the need for post-graduate study was fully recognized, but no comprehensive organization had been made in this country. For post-graduate education to be a success it must be associated with a general hospital and also special hospitals where instruction can be given in the wards, the out-patient clinics, the museum, laboratories and operating theatres. Lectures and demonstrations should be given in classrooms with all ancillary aids; writing, reading and refreshment rooms should be provided for the students who should also have the opportunity of acting as clinical assistants for a period of three to six months in the parent or affiliated special hospitals.

Before the 1914–1918 war there were three such post-graduate colleges in London each based on a general hospital: the North West London Post-graduate College (founded 1894) based on the West London Hospital; the North East London Post-graduate College based on the Prince of

Wales Hospital, Tottenham, and the Post-graduate School of Clinical Medicine based on the Dreadnought Hospital at Greenwich. These colleges were recognized for promotion purposes in the medical service of the Royal Navy, the Army, the Air Force, the Colonial and India Office. They were recognized by the University of London for the post-graduate instruction required by graduates before they could enter for the higher medical and surgical degrees.

Prior to that war, post-graduate classes had also been established in Edinburgh, Glasgow, Bristol, Manchester, Oxford and elsewhere, but no cooperation had been formed between the various centres.

The Inter-Allied Fellowship of Medicine and the Post-graduate Association

The foundation of a post-graduate association had been contemplated in London in 1917 as a large number of medical men who had served with the allied forces were for the time being domiciled there. There was unavoidable delay in the inauguration of the association, so in 1918 the Inter-Allied Fellowship of Medicine was formed with its headquarters at the Royal Society of Medicine. The object of the Fellowship was "to draw together the members of the medical profession of all the inter-allied countries, for the exchange of medical knowledge and advancement of medical science". The twelve medical schools in London agreed to cooperate by ward rounds, out-patient clinics, laboratory and operation theatre instruction. At the same time it was agreed that the claims of the undergraduates of the school should not be superseded by post-graduate instruction.

The Post-graduate Association was approved in April 1919 at a meeting of the representatives of the post-graduate schools and special hospitals under the chairmanship of the President of the Board of Education. A constitution was drawn up, a Council and an executive committee appointed to be in charge of the administration, with an office in central London, a library, recreation and refreshment rooms. In September 1919 a proposal to amalgamate the Fellowship of Medicine and the Post-graduate Association was agreed and authorized on 24th October 1919. The new body thus formed, having no definite accommodation of its own, decided, for the time being, to accept the invitation of the Royal Society of Medicine to establish there its headquarters.

The British Post-graduate Medical School

In 1921 the Minister of Health appointed a committee to investigate the needs of the general practitioners and other graduates in London for further education and to submit proposals for meeting them. The Committee recommended that a post-graduate school should be established devoted solely to post-graduate education and also be associated with the

University ; it also recommended the establishment of an Institute of State Medicine. The latter recommendation was realized first, hence the establishment of the London School of Hygiene and Tropical Medicine (1929) and also the Lister Institute of Preventive Medicine, neither of which is predominantly clinical. In 1925 a second committee was appointed to formulate a practical scheme to fulfil the first recommendation ; it reported in 1930. The committee had found it impractical to attach a post-graduate school to a general hospital in the centre of London and recommended that the school should be based on the Hammersmith Hospital, which had previously been administered by the London County Council. A third committee was appointed to plan the organization and constitution of the school. This committee, consisting of representatives from all the bodies interested in post-graduate medical education in London, was asked to arrange cooperation between them. There was some delay owing to the relative isolation of the Hammersmith Hospital and the reluctance of special hospitals to join the scheme in case that by doing so they lost their identity.

In July 1931 the British Post-graduate Medical School was incorporated by Royal Charter. It was associated with the Hammersmith Hospital (694 beds) and opened in 1935. It provided post-graduate education in medicine, surgery and pathology, but at that time it could not provide instruction in the special branches of medicine.

The British Post-graduate Medical Federation

The Inter-Departmental Committee on Medical Schools (1944) laid great stress on the development of post-graduate education. It was to further this development that in April 1945 the British Post-graduate Medical Federation was established by the University and incorporated by Royal Charter in March 1947; in December 1947 it was admitted a School of the University.

In 1945 the Governing Body of the School advised the University that the headquarters of the School should be in the centre of London, near the University, and that a Director or Dean should be appointed to be the administrative head.

The University having admitted a School or Institute to its organization could choose the staff, remunerate them, arrange the duties of the staff and provide the necessary amenities. The University could admit, into the Federation, Institutes in special subjects each being based upon a special hospital after being satisfied that the teaching would comply with University standards. The Director was to keep in touch with the various deans of affiliated institutes and undergraduate schools in London, also with the authorities conducting post-graduate education in other

Universities in Great Britain and the Commonwealth. These federated institutes should each be separately incorporated, each having its own Dean, Committee of Management, and Academic Board.

At the present time about fifteen Institutes teaching special subjects in medicine are included in the Federation, but not all are as yet, owing to financial stringency, able to provide ideal accommodation and the necessary amenities for research as well as teaching. The Federation since 1951 has included the Institute of the Basic Medical Sciences based on the Royal College of Surgeons of England. It was incorporated on 26th May 1956. That it has fulfilled a real need is shown by the fact that in 1951 there were during the year 250 students, whereas in 1960 there were 520.

Sir James Paterson Ross was elected to the Council of the Royal College of Surgeons of England in 1943 and ever since he has given generously of his time and experience as a member and often as Chairman of many important committees. For a time he guided the fortunes of the Institute of Basic Medical Sciences as the Dean. The climax of his surgical career came on 11th July 1957, when he was elected to be President of the College in succession to Sir Harry Platt, Bt. He was the seventieth holder of the office since its foundation in 1822.

St. Bartholomew's Hospital

The whole-time Professorial Surgical Unit was established in the Medical College of St. Bartholomew's Hospital in 1920 under the direction of Professor George Gask (1875–1951). The unit was an immediate success, due to the enthusiasm of George Gask and his team which included Thomas Dunhill as the Assistant Director. Paterson Ross was appointed a house surgeon in the unit in 1923 and has remained there ever since, succeeding Thomas Dunhill as Assistant Director in 1931 and George Gask as Director in 1935; when he was also appointed Professor of Surgery in the University of London. Since then he has worthily maintained and enhanced the tradition of the hospital as a teaching school.

St. Bartholomew's Hospital was founded in its present position in 1123 in fulfilment of a vow made in Rome, during an illness, by Rahere, a Canon Regular of St. Augustin, who earlier in his life had acquired a reputation as a minstrel, mime and jester at the Court of the King. He founded a priory as well as a hospital, both dedicated to St. Bartholomew and erected on the same site. The hospital was founded " for the feeble, the poor and the sick, for the delivery of women and should they die in childbirth, for the support of their children until they were able to support themselves ". The hospital and priory were finally separated by the dissolution of the priory in 1537. The hospital and its revenues thus came into the possession of Henry VIII, who in 1544 refounded the hospital

by Royal Charter at the request of the citizens of London supported by Thomas Vicary, his Serjeant Surgeon. In 1547 the King granted a further Charter, by which the greater part of its former revenues were returned to the hospital. On 29th September 1548 Thomas Vicary was appointed to be one of the six new Governors of the hospital and later to be Resident Surgical Governor ; he wrote the first book on anatomy printed in English (1548). He and his successors, namely William Clowes (1540–1604) and John Woodall, the author of the *Surgeon's Mate* (1636), did much to convert surgery from being a trade into a profession.

Throughout the centuries there have been at Barts many of the physicians and surgeons who have been well-known teachers, such as Percival Pott (1714–1788), John Abernethy (1764–1831), the two Pitcairns, uncle and nephew, both successively possessors of the " Gold Headed Cane," the two Lathams, father and son, Dr. Samuel Gee, whose aphorisms are still quoted and whose linctus is still popular. Sir James Paget (1814–1899), physiologist, pathologist and surgeon, achieved his eponymous fame by his work at the hospital. The most famous, of course, is William Harvey (1578–1657), physician to the hospital (1609–1644), who inaugurated by his researches and experiments a new era in medical thought and teaching, thereby laying the foundation of modern scientific medicine. The records of the hospital show that in 1662 students attended the medical and surgical practice there and its popularity increased to such an extent that in 1667 a library and in 1726 a pathological museum was formed for the use of the staff and students.

In 1734 the hospital authorities granted permission to the surgeons and assistant surgeons " to read lectures on anatomy in the dissecting room of the hospital ". Edward Nourse was the first surgeon to avail himself of this permission and in 1765 Percival Pott continued these lectures, which could be attended by students from other hospitals.

John Abernethy was elected as assistant surgeon to the hospital in 1787 and lectured so successfully on anatomy, physiology and surgery that a new lecture theatre was built in 1791 and a larger dissecting room in 1822. Sir James Paget was appointed Curator of the museum in 1834 and by 1846 had prepared the first fully documented catalogue. He was also in 1843 appointed as the first warden of the residential college established by the governors " to exercise discipline and preside at the common meal ".

In 1921 the Medical School was granted a Charter of incorporation, with the title " The Medical College of St. Bartholomew's Hospital in the City of London ", which enabled the College to take over the library, the museum and any property held in trust for the use of the school; it had to carry on the educational work and receive any endowments which might be made.

In 1945 a supplementary Charter enabled the College to admit women students, who had previously been specifically excluded.

The whole-time Professorial Clinical Unit inherited what has been termed the " Paget Tradition ", which determined that since the beginning of the present century its researches and teaching should be mainly directed to the surgery of function rather than structure. The teaching, as is well known, has maintained the reputation of the hospital and Sir James Paterson Ross from his previous experience will certainly add to that of the Post-graduate Medical Federation of the University.

Rahere founded a hospital and a priory; the latter has disappeared except for the church. His action was an inspiration as medicine and religion have always been closely related. The hospital has extended its influence and usefulness throughout the centuries. Although the priory has disappeared yet its influence will remain in the work of the hospital and its large Medical School. A school has many of the spiritual attributes of a monastery or abbey.

One can imagine Sir James Paterson Ross, in years to come, sitting quietly in the square on one of the seats " round the fountain " and thinking of many pilgrims he has seen enter the school as for their novitiate and in due course pass on to their work outside the gateway.

He may well have memories like those expressed by John Bunyan (1628–1688):

> " In this place there is a record kept of the names of them that have been pilgrims of old, and a history of all the famous acts that they have done. It is here also much discoursed how the river to some has its flowings, and what ebbings it has had while others have gone over. It has been in a manner dry for some, while it has overflowed its banks for others."
>
> (*The Pilgrim's Progress*)

FACULTY OF ANAESTHETISTS

At a meeting of the Board of Faculty on 19th October, Dr. Jacques Boureau, of Paris, and Dr. William George Cullen, of Montreal, were admitted to the Fellowship in the Faculty by Election. Dr. Rudolph Frey, of Heidelberg University, and Dr. James Urquhart Forbes, of Kuwait, had been admitted prior to this meeting.

The Dean reported that, on a recent visit to the United States of America, he had admitted Dr. Ralph Waters as an Honorary Fellow in the Faculty.

The Board agreed that the subject of the Scientific Meeting, to be held in the College on the 6th May 1961, would be " Hypothermia ".

SUPERVOLTAGE X-RAY THERAPY OF INTRACRANIAL TUMOURS

Hunterian Lecture delivered at the Royal College of Surgeons of England

on

17th March 1960

by

Arthur Jones, M.D., M.R.C.P., M.R.C.S., D.M.R.T.

Radiotherapeutic Department, St. Bartholomew's Hospital, London

I WOULD LIKE to thank you, Mr. President, and the Council of the College, for the honour of being appointed to deliver this Hunterian Lecture. My interest in brain tumours was first stimulated by you, Sir, when I was your dresser at St. Bartholomew's Hospital, and I am particularly gratified to have the opportunity of discussing their treatment under your Presidency. In basing this lecture on the Hunterian tradition, I was glad to find, with the help of Dr. Proger, the only specimen of a cerebral tumour in the Hunterian Collection. Regarded originally as a " hydatid " cyst, the tumour in its wall was first described in 1909 by Lawrence as a sarcoma. This is probably the specimen referred to by Hunter in his lectures as the only example he had encountered of hydatid cyst in the human brain. " This occurred in a lady in London, who had violent and distressing headache, and this increased almost to madness. The pain came on periodically, so that the cause could not be made out as the symptoms were not like those of depressed brain." The tumour may be an intraventricular metastasis. Despite the paucity of pathological specimens, a number of Hunter's concepts have an application to the problems of intracranial neoplasia. His comment on the treatment of cancer, that " no cure has yet been found; for what I call a cure is an alteration of the disposition and the effect of that disposition, and not the destruction of the cancerous parts ", is particularly appropriate to the treatment of brain tumours. For even malignant gliomata rarely metastasize (and not outside the cerebrospinal axis); they would often be amenable to excisional surgery were it not for the insupportable neurological deficit which their radical removal would entail. Because of this, with the advent of radium and deeply penetrating X-rays, the possibilities of radiotherapy were explored.

The great advances in X-ray therapy since it was first employed in brain tumours (Nordentoft, 1922) came initially from physical developments. With accurate dosimetry, and increasing penetration from using higher voltages, radiotherapeutic technique moved nearer its first goal, the adequate and uniform irradiation of the tumour-bearing volume with sparing of the normal tissues. Then came radiobiological progress,

concerned particularly with the effects of varying the magnitude and fractionation of the radiation dose. Real appreciation of the clinical effects of irradiation on intracranial tumours has, however, been dependent on advances in two other streams—the study of the natural history of the gliomata, and research on the radiosensitivity of the normal brain—and these must be considered if technical developments are to be placed in perspective.

Classification and natural history of gliomata

Although it had been recognized since the time of Virchow (1867) that most of the tumours arose from the interstitial (as opposed to the neuronal) tissues of the brain, the most important advance came in 1926 with the publication of Bailey and Cushing's *Classification of the tumors of the glioma group on a histogenetic basis, with a correlated study of prognosis*. Basing their studies on the development of the nervous system, they showed that longest survival periods were associated with the more highly differentiated tumours, and vice versa; their important contribution was, in fact, the recognition of the " behaviouristic " features of these tumours from a prognostic point of view. Bailey and Cushing's classification was widely accepted, but its disadvantages were the large number of tumour types, and the fact that some gliomata derive from more than one basic cell type. As Bailey (1948) subsequently emphasized, only occasionally are tumours composed of a single type; most are made up of several types of cell, which at best reproduce but crudely the normal embryonic cells. But " on looking at the kaleidoscopic continuum of brain tumours " familial resemblances emerge, with certain cellular types dominating the appearance. Thus Bailey recognizes 10 groups of brain tumour, the now familiar glioblastoma multiforme, astrocytoma, medulloblastoma, oligodendroglioma, spongioblastoma polare, astroblastoma, ependymoma, pinealoma, ganglioneuroma, and neuroepithelioma.

Kernohan, Mabon, Svien and Adson (1949) at the Mayo Clinic suggested a classification based on the idea that gliomata arise from a pre-existing adult astrocyte, oligodendrocyte and ependymal cell. In particular, in the astrocytoma group they recognized a gradual transition between the lowest and highest grades of malignancy; they proposed for this commonest of brain tumours the grading of 1–4, grade 4 corresponding with the highly malignant glioblastoma multiforme. The scheme has gained increasing acceptance, but, as Zimmerman (1955) pointed out, its major fault is the assumption that each glioma takes origin from a single cell.

Fascinating experimental evidence has been produced by Zimmerman to show that under chemical stimulation many different adult and

morphologically distinct glial cells begin to proliferate almost simultaneously to produce a glioma. The tumour is multi-potential, but by selective transplantation relatively pure strains can be obtained; moreover, the methylcholanthrene injected into various sites of the brain produced the commonest naturally occurring tumour at that site—glioblastoma or astrocytoma of the cerebral hemisphere, medulloblastoma in the posterior fossa.

A main use of classification is its aid to prognosis, and the Mayo Clinic classification has recently been simplified by Earle, Rentschler and Snodgrass (1957) for the astrocytomas: the three groups being glioblastoma multiforme, with an average postoperative survival of 6 months, well differentiated astrocytoma (44 months) and poorly differentiated astrocytoma (23 months).

Implicit in the classification of Kernohan is the concept of tumours arising by " de-differentiation " of adult cells, and there is no doubt that such de-differentiation plays an important part in determining the natural history of some gliomata. Thus a tumour may be extremely anaplastic from the start—as often with glioblastoma multiforme; or the development of a well differentiated tumour over many years may later result in areas of anaplasia appearing and with them an increased tempo of growth.

Such considerations have important implications when assessing the natural history of a tumour to which a given label has been attached: and even more so when attempting to measure the effect of a therapeutic agent. Because of pleomorphism of the tumour a biopsy may give limited information by revealing only an atypical area. Also, anaplasia may supervene at any time in the history of an astrocytoma, so that a patient may be treated for a grade 2 astrocytoma (and indexed according to the biopsy); then, after surviving three years, autopsy may reveal most of the tumour to be of grade 4 (glioblastoma multiforme). Evidently both the biopsy and the autopsy taken alone may give misleading labels by which to judge the effects of treatment.

The natural history of a glioma can only be assessed in retrospect, and for such tumours as the better differentiated astrocytomata and oligodendroglioma this may involve observation over many years—often for a decade. Even within a given tumour type, the natural history may be very variable by reason of the patient's age and the tumour's proximity to vital centres. We have therefore in the gliomata a group of tumours showing great diversity of behaviour despite the misleading tidiness of the histological labels. We must bear all such features in mind when assessing the results of treatment, and, having obtained the maximal amount of information from a sufficient number of cases, approach the interpretation with circumspection.

Radiosensitivity of normal brain

Many years passed before the ultimate effects on the nervous system of penetrating ionizing radiations were appreciated. The main factors delaying their recognition were the latent period (of months to years); the clinical evidence of untoward sequelae being often overshadowed by signs of persistent tumour; and the pathological changes of irradiation themselves often simulating the appearance of glioma. Undoubtedly, late radionecrosis of brain has been produced with regularity by high dosage and repeated courses of irradiation (e.g. Fischer and Holfelder, 1930; O'Connell and Brunschwig, 1937; Wachowski and Chenault, 1945; Pennybacker and Russell, 1948; Boden, 1950; Malamud, Boldrey, Welch and Fadell, 1954; Arnold, Bailey and Harvey, 1954); but some of the earlier accounts are difficult to evaluate radiobiologically because of uncertainties of dosage and irregular fractionation. The now classical studies of O'Connell and Brunschwig demonstrated degenerative changes in the normal brain apart from the effects of irradiation on the glioma, and produced evidence for the primary effect being neuronal and glial rather than vascular. Pennybacker and Russell, however, were impressed by the vascular changes in their own material, and concluded that the degeneration and necrosis were consequent on the fibrinoid necrosis, thrombosis and collagenous thickening of the perforating vessels in the brain.

This aspect was pursued in an experimental study (Russell, Wilson and Tansley, 1949) in which radionecrosis of the rabbit's brain was produced by a single X-ray dose of 2,850 r. The initial changes consisted of minute foci of haemorrhage and necrosis intimately related to perforating vessels and capillaries, the neurones being only focally and secondarily affected. Russell *et al.* are careful to point out that it cannot be assumed that the evocative dose of X-rays for the rabbit's brain will be followed by similar changes in other species. When the effects of 23 MeV betatron X-radiation on the brains of primates (monkeys) were studied by Arnold, Bailey and Laughlin (1954), the *acute* effects (for single massive doses) seemed to be direct and not secondary to vascular occlusion.

In most experimental studies the doses have been moderate, high or very high, but delivered as a single event, which can have little relevance to even the same dose fractionated over 4–6 weeks in clinical radiotherapy. Clinical interest attaches therefore to the effects of the lower experimental doses (e.g. 1,500 r), and Clemente and Holst (1954), investigating changes in neurones, neuroglia and the blood-brain barrier, found lesions in monkeys 4–8 months after such irradiation. As vascular effects are more likely to follow when individual dose fractions exceed the vascular endothelial threshold, the fallacy of extrapolating to man the effects of single doses is obvious.

While the evidence is unequivocal that high doses of radiation are noxious to nervous tissue, information is still incomplete on the relative frequency of degeneration caused by the dosage range of 4,000–6,000 r. Thanks, however, to the studies mentioned, there is greater appreciation of the limited radiation tolerance of the normal brain, and doses of above 5,000 r in five weeks are now regarded as potentially dangerous for the cerebrum. The important work of Boden (1950) (based on clinical effects noted when the brain was incidentally irradiated) indicated the radiation tolerance for small volumes of the brain stem to be not greater than 4,500 r in 17 days.

It is evident that despite technical advance in radiotherapy, the radiosensitivity of the normal brain will often act as a halter on unbridled progression towards very high dosage.

Potential advantages of supervoltage radiations

Supervoltage X-ray therapy, using beams produced at energies of over one million volts, has been shown to have distinct advantages over conventional (250 kV) X-rays in the treatment of a number of neoplastic diseases. These advantages depend on the physical factors of increased penetration, stricter beam collimation, relatively uniform density of ionization even in heterogeneous media such as bone, the depth of the maximal ionization below the skin surface, and the high X-ray flux permitting treatment at long distances. As the cerebrum is contained in the bony calvarium and the brain stem is shielded by dense petrous bones, these *a priori* considerations might be applicable with advantage to the treatment of brain tumours.

MATERIAL OF STUDY

Treatment of patients with the million volt X-ray apparatus in the Sassoon Department at St. Bartholomew's Hospital was started in 1937, and among the early cases were a number of intracranial tumours (Phillips, 1945). For this present investigation, all cases of primary intracranial tumour, 139 in number, treated by million volt X-irradiation between the years 1937 and 1953 inclusive have been studied, and the results assessed as at 31st December 1958. There is thus a minimum follow-up period of five years for the series. All cases have been completely followed up to the date of death or to the present time, the maximal period of observation being 18 years. In discussion of the technique of treatment planning, and of the early reactions to irradiation, use has been made of experience of treating 100 further cases since January 1954 (but these are not used in assessing results). Pituitary tumours are not included.

The majority of the patients were referred by clinicians at St. Bartholomew's Hospital, particularly from the Department of Neurological Surgery (Mr. J. E. A. O'Connell), although a number of cases came from

other sources. The distribution of cases among the various types is shown in Table I. The term " clinical glioma " is used to denote those cases in which histological confirmation was lacking, although the clinical picture, special investigations and subsequent course indicated this to be the true diagnosis. The four cases designated " various " were a sarcoma, a chemodectoma, a cirsoid aneurysm and one of unknown nature. Pathological diagnoses came from a number of sources and it has not been possible to review all the sections; in each case the maximal information available (e.g. subsequent autopsy) has been used to indicate the diagnosis

TABLE I

TOTAL SERIES OF PRIMARY INTRACRANIAL TUMOURS TREATED BY SUPERVOLTAGE IRRADIATION, 1937–1953

A.	Histologically proven glioma		85
	i. Astrocytoma	31	
	ii. Glioblastoma multiforme	33	
	iii. Oligodendroglioma	5	
	iv. Ependymoma	3	
	v. Glioma unspecified	13	
B.	Clinical glioma		34
C.	Medulloblastoma		5
D.	Meningioma		7
E.	Papilloma		1
F.	Haemangioma		3
G.	Various		4
	TOTAL		139

as listed. It is not possible to formulate the degree of selection of the patients treated over a period of 20 years. Radiotherapy has been given to all cases which could reasonably be expected to benefit from it, and the presence of the supervoltage department within a large general hospital has enabled treatment to be given to a number of patients who were unconscious or otherwise bedridden. Such considerations may indicate an unduly high proportion of advanced cases, but it is doubtful whether the distribution is very different from that in most radiotherapeutic centres.

PHYSICAL ASPECTS

The million volt (1 MeV) apparatus, depending on the Cockcroft and Walton principle, has been described by Phillips (1945) and Innes (1948). The physical factors employed in this investigation were as follows: 1 MeV, 4.5 mA, 100 cm. focus skin distance, Half-Value Layer 9.3 mm. Cu (filter 4.2 mm. Fe + 2 mm. Al + 2 mm. Pt + 2 mm. Al); surface dose rate (with back-scatter) 40 r per minute for 10×10 cm. field. The original dose distributions were made in Presdwood phantoms, but to clear up uncertainties about heterogeneous media these have now been compared with actual measurements within the skull and brain. A special cadaver preparation was used of a cranium bisected sagitally, retaining the brain

and soft tissues in place. To hold ionization chambers in position a plate of Perspex (1 in. thick) was prepared, to be exactly the same shape as the hemi-cranium, on to which it was superimposed (Fig. 1). The Sievert chambers lie in holes drilled at selected points of interest. Lateral irradiation of the specimen was carried out with a beam subtending the whole skull, under conditions of full back-scatter, and the depth doses from the 1 MeV beam were compared with those at 250 kVp (15 mA., Thoreaus filter, H.V.L. 2.5 mm. Cu., 60 cm. F.S.D.). Similar comparisons

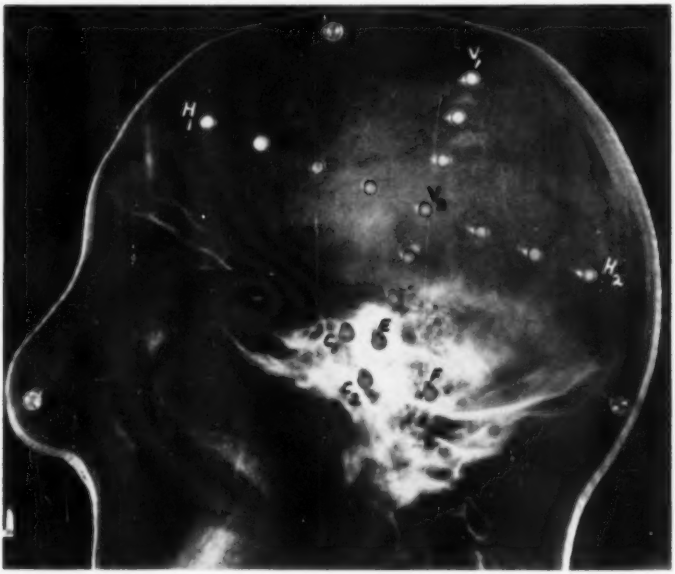


Fig. 1. Positions of ionization chambers in Perspex plate for dosage measurements in brain, shown on radiograph of hemicranium (cf. Table II).

were made in a Presdwood phantom, and the results are shown in Table II. In addition to the increased depth dose at 1 MeV, there is greater uniformity compared with the 250 kV beam. While this is apparent at the falx cerebri, it is particularly seen in the measurements at the midline of the clivus; and the effect of a hollow canal is seen in the results for the ionization chamber at the internal auditory meatus.

The increased depth dose at 1 MeV and the appreciable exit dose do not diminish the effectiveness of irradiation by opposed fields. In view of the importance of adequately irradiating midline and contralateral

TABLE II

COMPARISON OF SAGITTAL PERCENTAGE DEPTH DOSES, IN PHANTOM AND SKULL-BRAIN, AT 250 KV. AND 1 MEV.

Site (Fig. 2)	*Percentage Depth Dose*			
	250 kV.		*1 MeV.*	
	Phantom	*Skull-brain*	*Phantom*	*Skull-brain*
Falx cerebri (H_1 — H_2)	52	48.5	66.5	66
Falx cerebri (V_1)	54	48.5	66.5	66
Falx cerebri (V_2)	54	50	67.5	67
Clivus (C_1)	53	48	67.5	66
Clivus (C_2)	53	47	67.5	66
Int. auditory meatus (E)	52	52	67.5	67.5
Posterior Fossa (F)	52	48.5	66	65.5

extensions of gliomata (*vide infra*), and the increasing application of supervoltage therapy, it was of interest to examine the conditions at energies above 1 MeV under which opposed field irradiation is advantageous. Isodose charts have been computed for opposed fields of radiation from this 1 MeV apparatus, from a radiocobalt telecurie apparatus (at 80 cm. S.S.D.), and from 4 MeV and 15 MeV linear accelerators at 100 cm. F.S.D. These show that suitable distributions are readily obtained near the basicranium; but the skull curvature over the vertex (necessitating the use of bolus) results in a localized high skin dose and vitiates the benefits to be derived from the " build-up " of ionization. These difficulties may be overcome by incorporating appropriate wedge filters in the beam, but such differential absorbers would need to be shaped in two planes and individually constructed for each patient. The ideal radiation distribution for the typical glioblastomatous tumour is best obtained by rotation or arc techniques at the energies of ^{60}Co or 4 MeV (Fig. 17).

TREATMENT PLANNING AND TECHNIQUES

In assessing the site and volume to be irradiated for an intracranial tumour, there remain in most cases a number of imponderable factors, despite the advances in investigational methods of neurosurgery of recent years. It is clearly important to have available the maximal amount of information which each method can provide, and this entails close collaboration between the neurosurgeon and the radiotherapist. To the data provided by clinical methods are added the results of diagnostic radiology (including arteriography), exploratory craniotomy and histological examination of the tumour. Clinical examination and radiological methods give valuable information as to the site of the tumour, but usually less as to its actual extent. Since infiltrative and destructive growth of glioma are not synonymous, a tumour may " silently " infiltrate large volumes of the cerebrum, and the absence of focal signs does not necessarily mean that a tumour has not in fact extended to that particular area. The operative findings in cases subjected to exploratory craniotomy

give information as to the macroscopic superficial extent of the lesion but, unless partial excision has been performed, rarely indicate its medial limit; this must be determined from clinical examination, radiology, and from consideration of the histology.

Regarding radiological localization, Bull and Rovit (1957) have shown that, while crude tumour localization could be obtained in a high percentage of cases, in less than one half of all the cases studied could precise definition of the tumour outline be obtained. Of all their cases having tumours in one of the primary brain lobes, 64 per cent. had involvement of deep or midline structures, and about three-quarters of all the parietal

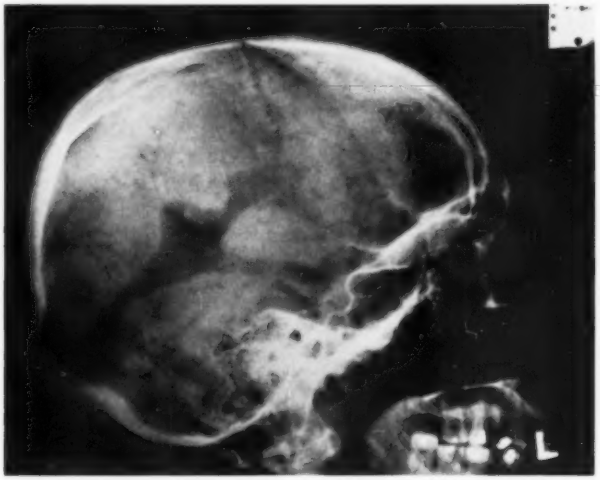


Fig. 2. Intraventricular projection of ependymoma. This tumour may have a purely expansive pattern of growth, of significance in planning radiotherapy.

lobe gliomata extended deeply and centrally. Moreover, *one-quarter* of all cases studied showed macroscopic or histological evidence of *bilateral* involvement of the brain. Although their cases were a selected series—in that all patients had died within four and a half months of radiological investigation (the tumours being thus of the more aggressive type), and the findings were of course based on autopsy examination—the data of Bull and Rovit are of importance in the planning of radiotherapy.

Histological considerations are important in assessing the probable tumour volume in these respects: (*a*) Biopsy may reveal an innocent although inoperable tumour, such as a meningioma or haemangioma, amenable to strictly localized irradiation. (*b*) Ependymoma is the only

type of glioma, according to Scherer (1940), which shows purely expansive growth and whose limits may thus be defined with fair accuracy. (*c*) All other gliomata are infiltrative, and the majority are much more extensive than would macroscopically appear. Their growth zones extend irregularly as finger-like projections in various directions, all of which must be included in the volume to be irradiated. (*d*) Moreover, Scherer believed that the cerebral (in contradistinction to cerebellar) astrocytomata are primarily diffuse gliomatous processes, a concept to be considered in planning their irradiation. (*e*) Finally, should the biopsy reveal a metastasizing tumour, such as medulloblastoma, irradiation of the whole cerebrospinal axis would be indicated.

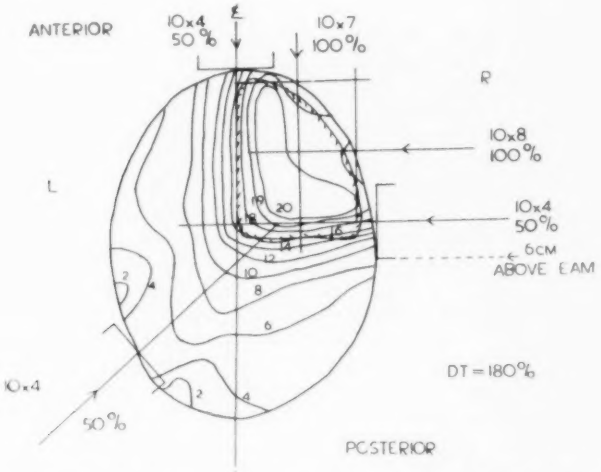


Fig. 3. Typical isodose for 1 MeV X-ray therapy of right frontal tumour. (A "wedge" technique is simulated by the superimposition of small fields at the periphery of the two main fields.)

Because of the number of biological factors involved, the variable contour of the cranium, and the physical properties of the supervoltage beam (including regard for each exit dose) standardization of technique is not feasible. In each of the 139 cases of the present series (and in a further 100 cases treated since 1953) full and individual isodose assessment has been carried out. As outlined above, the degree of accuracy with which the tumour may be delineated varies a great deal. It is probably greatest in the case of a true pinealoma, and least of all in cerebral astrocytoma. In the case of an ependymoma air studies may reveal an intraventricular defect (Fig. 2) and as the growth process is often expansive the continuation of the contour into the hemisphere may indicate the intracerebral

extent of tumour. In planning the irradiation of other cerebral gliomata the ultimate volume may occupy half a hemisphere, or even two-thirds in the case of an astrocytoma; the medial limit almost always extends to the midline and in glioblastoma often into the opposite hemisphere. A typical isodose plan is shown in Figure 3 and indicates how much homogeneity may be attained in a comparatively large volume with sparing of normal brain tissue. If, however, the tumour extends far into the contralateral hemisphere, a simple arrangement of opposed fields provides the best distribution for lesion doses of up to 4,500 r in four weeks. The curvatures of the head prevent full use of the skin-sparing effect of the supervoltage beam and the isodoses are therefore compiled for full bolus of fields.

Special care has to be exercised in supervoltage therapy to avoid irradiation of the eyes, not only from incident beams but also from the high depth dose of posterior or oblique lateral beams. Temporal lobe tumours are a special problem, for while the eye may be readily protected from a direct lateral field, its protection from above and behind is more difficult. This difficulty has been overcome by planning the isodose in a plane tilted above and behind the orbit while still including the tip of the temporal lobe, instead of irradiating in a plane parallel to Reid's base line.

REACTIONS TO IRRADIATION

Early Reactions. The clinical phenomena observed during X-ray therapy, and attributed to irradiation, must be distinguished from those which occur in the natural history of the tumour and following surgical measures used in diagnosis and treatment. Episodes of headache, vomiting, drowsiness and disorientation, common in cases having raised intracranial pressure, may continue during part of the course of treatment. Temporary changes in hydro-dynamic relationships in the brain and C.S.F. may follow ventriculography or burr-hole biopsy, and irregular pyrexia (99°–104° F.), and tachycardia or bradycardia may ensue for days or weeks. These effects are seen less frequently in patients given post-operative radiotherapy after partial tumour removal, when the radiation is given later, internal decompression is present and the C.S.F. pressure relationships have tended to greater stability. Epilepsy may occur (despite anticonvulsants prescribed routinely after excisional surgery) and its recognition is important. While overt convulsions are easily recognized, the manifestations may be atypical, and a state of coma may be misinterpreted unless prodromal symptoms (e.g. slight twitching) have been noted. On the other hand, some patients become unduly drowsy from phenobarbitone gr. 1 twice or thrice daily, and the drugs and dosage require adjustment.

Superimposed on these phenomena may be those related to irradiation itself, and in general they are proportional to the pre-existing disturbances of intracranial pressure. Thus a patient receiving supervoltage X-ray therapy, after subtotal removal of a well-differentiated cerebral astrocytoma, usually shows no pressure symptoms or signs throughout the course of 4,000 r given in 28 days. But a patient being irradiated for temporoparietal glioblastoma multiforme with raised pressure, after a burr-hole biopsy, may have exacerbation of headache and vomiting after relatively small doses of radiation (100–150 r). The initial dose in such cases is therefore kept down to 50–75 r, and increased as tolerated over the first week of treatment. Patients, especially children, having tumours of the posterior fossa irradiated are well known to be the most susceptible to radiation pressure reactions, because of the confined volume, and radiotherapy is very rarely given without preliminary exploration and suboccipital decompression. Even with a decompression, irradiation of residual tumour which adheres to or involves the brain stem may give rise to an acute reaction. (The presence of an infiltrative tumour is not a prerequisite, as in one adult with inoperable cerebellar haemangioma X-ray therapy had to be interrupted after 1,200 r in seven days, but was later satisfactorily resumed.) Such reactions may often be circumvented by judicious fractionation of the initial doses. Once conditions have become stabilized, reaction by cerebral oedema is rare, but may supervene in the later states of irradiation (at 3,500–4,000 r): in such cases of glioblastoma multiforme it may continue for 2–3 weeks after the completion of treatment. The symptoms have been treated by the usual measures to reduce raised intracranial pressure, e.g. restriction of fluid intake, magnesium sulphate enemata, and raising the head of the bed; as an emergency measure, intravenous injection of 100 ml. of 50 per cent. sucrose solution has on occasion enabled X-ray therapy to be continued when acute and severe pressure symptoms had occurred.

Skin Reaction. As the contour of the head prevents full use being made of the skin-sparing effect of the supervoltage beam in multiple-field therapy, bolus has been used in accordance with the planned isodose. Small areas of scalp, particularly in the curving fronto-parietal region, may receive 4,000–4,500 r for an equal tumour dose, and the usual reaction has been a second degree erythema with epilation. Four cases developed generalised "toxic erythemata"; in recent years a major cause of this unusual radiotherapeutic reaction (sometimes associated with eosinophilia or thrombocytopenia) has been the irradiation of glioblastoma multiforme.

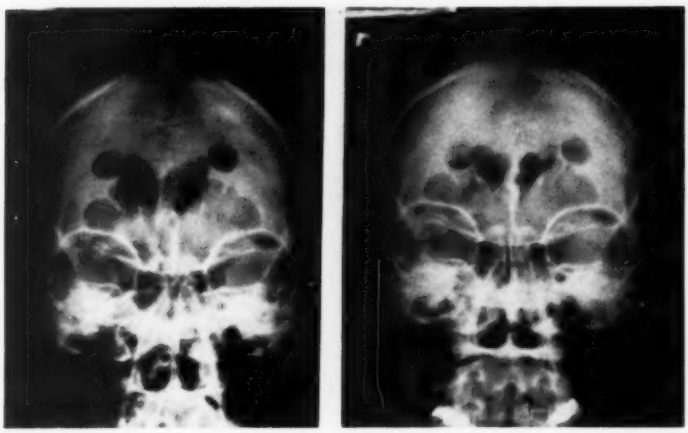
Late sequelae. The syndromes of late radionecrosis of brain are characterized mainly by signs of progressive neurological deficit originating in a volume of brain previously irradiated, without evidence of increased intracranial pressure, and occurring after an interval of from

3 months to 5 years after irradiation. In suggesting such a diagnosis on clinical grounds it must be remembered that many gliomata, treated by partial excision and internal decompression, may proceed to a fatal termination by infiltration of vital structures, while producing little evidence of raised intracranial pressure. In this series no delayed ill effects have been seen in patients who received tumour doses of 4,000–4,500 r in 28 days, and interest attaches particularly to those receiving higher doses. Of 24 cases (5 non-gliomatous) receiving 5,000–5,800 r in periods of from 19 to 35 days, 16 survived for more than two years, and no case showed clinical evidence of cerebral radionecrosis. (In one case scalp atrophy interfered with healing of subsequent surgery, but the subcutaneous induration previously described with supervoltage therapy [Jones, 1948] has not been seen in the scalp.) Ten cases received tumour doses of over 6,000 r in 25–57 days for gliomata, the highest dose being 7,500 r, and the survivals varied from 4 to 56 months. In most cases any clinical evidence of cerebral radionecrosis would have been overshadowed by the signs of persistent or recurrent tumour. In one case (in which X-ray therapy [6,000 r/30 days] had been preceded by delayed healing of the scalp wound), necrosis of the scalp and bone flap supervened four years after irradiation ; and although it seemed probable on clinical grounds that cerebral radionecrosis had also occurred, there was no autopsy. As most of these patients died elsewhere and few autopsies were obtained, the information provided is largely of a negative nature. There has at least been no clinical evidence of untoward sequelae at doses of 4,000–5,000 r in 4 to 5 weeks; but the literature contains sufficient salutary reminders of likely hazards beyond this dosage range.

ASSESSMENT OF THE RESPONSE TO RADIOTHERAPY

The assessment of the immediate response and radiosensitivity of intracranial tumours is difficult. The tumour itself cannot be directly observed and even its original size is often a matter of conjecture. While air studies and arteriography may have given valuable diagnostic assistance, to repeat these studies after irradiation would seldom be justified, even if they could give worthwhile information. Serial biopsies, because of the chances of obtaining material atypical of the whole tumour, would be more likely to mislead than to help. The information on radiosensitivity is therefore indirect; it depends on observing how pressure changes set up by a space-occupying lesion, how the neurological disturbance, and how the natural history of the tumour process may be modified by irradiation. If a tumour such as a glioblastoma multiforme, with a relatively short history of steadily rising intracranial pressure, is subjected to irradiation, the effects noted in the subsequent weeks *may* be attributable to the irradiation, with certain reservations. Spontaneous necrosis and haemorrhage are common in glioblastoma, and the ensuing sudden deterioration may spontaneously improve; if

radiotherapy is started after such an episode the improvement may be wrongly attributed to irradiation. Again, a tumour such as an astrocytoma (Grade 2) may produce a history of epilepsy for perhaps 2–5 years, and investigation reveal only minimal pyramidal tract signs; after ventriculography and biopsy the condition may rapidly deteriorate, later to improve over a number of weeks. To attribute to radiotherapy, given immediately after the biopsy, the improvement noted during these weeks would be fallacious ; the change for the better noted by the radiotherapist during his course of treatment is merely a restoration of *status quo*. In fact, the radiosensitivity of such an astrocytoma can only be determined in relation to its natural history extending over a number of years.



(*a*) (*b*)

Fig. 4. Spontaneous readjustment of hydrocephalus and remission of symptoms with continued growth of astrocytoma. (*a*) Ventriculograph showing dilatation of lateral ventricles: extensive tumour of both frontal lobes and corpus callosum. (*b*) Repeat ventriculograph nine months later: reduction in dilatation despite increased growth of tumour.

An extreme example of the variable natural history of astrocytoma was the case of a woman of 49 admitted with a year's history of personality change and of severe headaches for 6 months. She was drowsy, responded only to painful stimuli, and had high papilloedema. Ventriculography (Fig. 4 (*a*)) demonstrated an extensive tumour involving both frontal lobes, corpus callosum and septum pellucidum. Burr-hole biopsy showed the tumour to be a grade 2 astrocytoma. Because of the patient's poor general condition she was not referred for radiotherapy, and returned home. In subsequent months her condition gradually improved and the headaches disappeared. Six months after leaving hospital she was alert and able to walk with help; her vision good; and optic discs now flat. Repetition of the ventriculography (Fig. 4 (*b*)) now revealed a reduction in the size of the lateral ventricles, indicating improved C.S.F. circulation, but also increase in the extent of the tumour. The symptomatic improvement in the last nine months had occurred from the improved C.S.F. circulation, presumably due to change in tumour relationships without irradiation.

Such a phenomenon must be very rare, but minor degrees should be considered when great symptomatic improvement follows but slight tumour reduction after radiotherapy.

The assessment of cases irradiated postoperatively, after partial tumour excision and internal decompression, is even more difficult. The signs of raised pressure are already abating because of the decompression, and the neurological deficit may be partly due to the tumour but also to

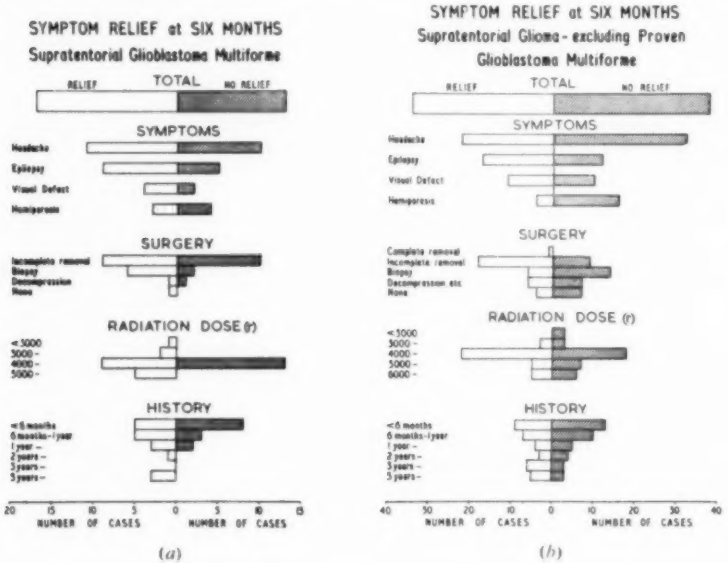


Fig. 5. Analysis of the relief of symptoms in cases of supratentorial glioma six months after radiotherapy: (*a*) glioblastoma multiforme; (*b*) other gliomatous tumours. Headache was relieved in 11 of 21 cases of glioblastoma. Hemiparesis benefited least (improved in three of seven glioblastomatous cases, but only in 4 out of 20 other tumours). The effect of drugs vitiates analysis of epilepsy; and the varying incidence of surgical procedures prevents correlation of radiation doses.

the effects of surgery. Many of the signs of deficit after surgery are transient in degree, and the period when improvement occurs is likely to coincide with the period of postoperative radiotherapy. It is apparent that if the immediate response to irradiation is to be assessed with any degree of accuracy, the analysis must be confined to those cases in which the hydrodynamic C.S.F. relationships are in a steady state before irradiation, which show physical signs capable of ready gradation, and where radiotherapy is effectively the sole therapeutic agent. The factors mentioned weigh on the side of attributing radiosensitivity when that

degree may not be present. Concepts of radiosensitivity usually depend on effects noted during and immediately after irradiation, and the delayed response of some tumours may result in their being regarded as insensitive, while the patients nevertheless improve over a period of months. In this series the response has been assessed from the point of view of relief of symptoms at the end of 6 months (Figs. 5 (*a*) and (*b*)).

ANALYSIS OF RESULTS

Of the total number of 139 patients, all were followed up, and 21 were found to be alive more than five years later (Table III). Two cases were shown to have died of causes other than the primary intracranial tumour (one being an air-raid casualty and the other, to be

TABLE III

FIVE-YEAR SURVIVAL FIGURES OF WHOLE SERIES OF PRIMARY INTRACRANIAL TUMOURS, 1937–1953

Total number of patients 139
Number alive on 31st December 1958 21
Number died of other causes 2

	Total	*Alive*	*Died*	*Died other cause*
Glioma Group				
A. Histologically proven glioma	85	11	74	0
B. Clinical glioma	34	4	29	1
Total glioma group	119	15	103	1
Medulloblastoma	5	0	5	0
Meningioma	7	1	5	1
Papilloma	1	1	0	0
Haemangioma	3	2	1	0
Various (see text)	4	2	2	0

mentioned later, dying of another tumour). The lethality of the gliomata is represented by only 15 of the 119 cases surviving for more than the five years. Tumours arising below the tentorium cerebelli have such a distinctive type and age incidence, natural history and duration, that they must be separated in any analysis from the supratentorial gliomata which form the major group.

I. SUPRATENTORIAL GLIOMA GROUP

This large group of 102 cases is composed of astrocytoma (grades 1–3) 25, glioblastoma multiforme 30, oligodendroglioma 5, ependymoma 1, glioma unspecified 10, and clinical glioma 31 cases. The average survival was 33.8 months; and the survival periods for these tumours are compared in Table IV. It is apparent that while three-year survival figures may be significant for such a rapidly progressive tumour as glioblastoma multiforme, they are misleading for astrocytoma and oligodendroglioma, in

TABLE IV

SURVIVAL PERIODS FOR SUPRATENTORIAL GLIOMATA

Tumour Type	*No. of Patients*	*No. alive >3 years*	*No. alive >5 years*	*Survival in years* 0–¼	¼–½	½–1	1–2	2–3	3–4	4–5	5
Astrocytoma	25	8	6	3	0	2	5	5	4	0	6 (3+)
Glioblastoma m.	30	3	0	1	2	6	11	7	2	1	0
Oligodendroglioma	5	2	1	1	0	1	1	0	0	1	1
Ependymoma	1	1	1	0	0	0	0	0	0	0	1+
Glioma unspecified	10	3	1	0	2	2	1	2	0	2	1+
Clinical glioma	31	9	5	4	5	4	2	7	1	3	5 (3+)

which the picture of survival changes slowly and progressively. The results in this large supratentorial group have been analysed with respect to factors affecting the natural history: age, duration of symptoms, and site; and the radiotherapeutic factors of dose-time and volume irradiated.

Age. The influence of age on survival has engaged the attention of many observers; and as Penman and Smith (1954) pointed out in their series "youth and a comparatively long survival period were strongly associated". In the present cases a marked age effect was also apparent. On arbitrarily separating the patients aged 35 or over from those below that age, younger patients in each group had a distinctly longer survival. The "age effect" is most marked in glioblastoma multiforme (Fig. 6), where the median survival for patients under 35 is 29 months, compared with 14 months for the older age group; this is evidently an important factor when considering possible effects of other variables on survival. For other gliomata the age effect is less potent: for histologically proven gliomata (excluding glioblastoma [Fig. 7]), the median survivals are 37.5 and 24 months for the two age groups.

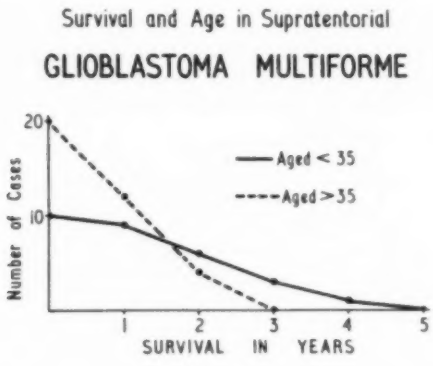


Fig. 6.

Duration of symptoms. Of all the parameters considered, the duration of symptoms is the least reliable both from the patient's history and its subsequent interpretation. While the onset of symptoms of progressively raised intracranial pressure may be dated with fair accuracy in a fully alert, co-operative patient, once consciousness is blurred, the sense of time and of recall may become unreliable. Difficulties are also encountered by the observer in assessing the significance of episodes of e.g. headache, extending perhaps over many years. In the case of epilepsy it would be unrealistic to discard even a very prolonged history as irrelevant to the growth of the tumour.

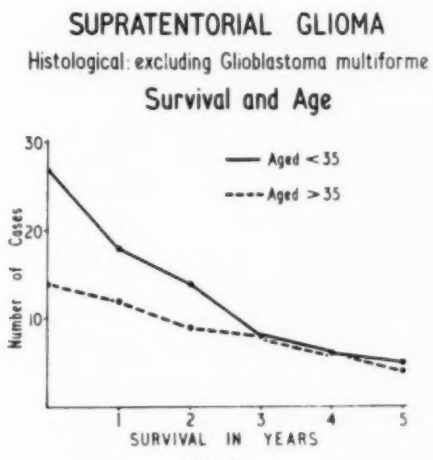


Fig. 7.

One patient aged 39, having an astrocytoma grade 2 of the left fronto-parietal region, had a history of Jacksonian epilepsy extending over 23 years; the attacks occurred once a week until three years before treatment, when they increased in frequency to four times a week, and symptoms of raised intracranial pressure ensued only two months before hospital admission. Such epilepsy is of special interest from the point of view of the initiation of a neoplastic process. Because of the minute size of the cortical lesion which may act as an epileptogenic focus, it would be possible for a cerebral tumour to be manifest clinically at an earlier stage of growth than any other tumour in the body. But examination of pathological specimens has in the past revealed the earlier development of an extensive tumour to be usually a silent process as far as cortical activity is concerned. Recently Falconer and Cavanagh (1959) have found

small focal lesions in one-third of their cases of intractable temporal lobe epilepsy submitted to operation (without unequivocal radiographic evidence of a space-occupying lesion). Of the 23 lesions, 13 were small tumours associated with an average preoperative epileptic history of 8 years; 11 of the tumours were gliomata, and no recurrence was found 2–7 years after possibly incomplete removal, implying a remarkable degree of indolence. In the brain there may therefore be analogies with the early development of tumours of the bronchial epithelium and of the prostate.

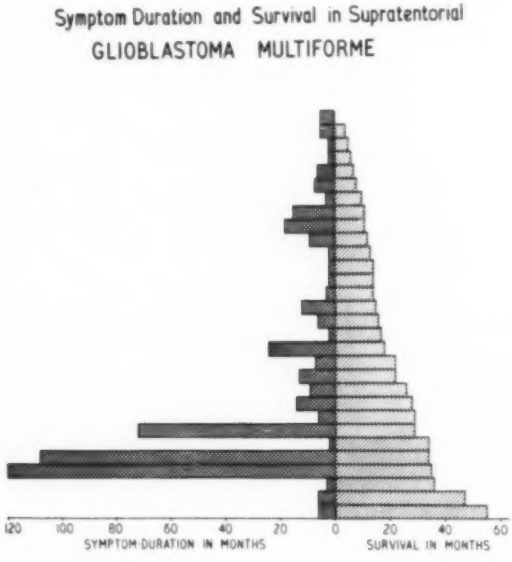


Fig. 8.

In the present series of supratentorial gliomata there is a very considerable range of symptom-duration for all types of tumour. For glioblastoma multiforme, the shortest, it varied from 2 to 120 months; but only three cases had histories of more than 24 months, and these were of 72, 108 and 120 months. If we examine those cases with less than 12 months' history, to find the proportion alive *two years* after treatment, we find only 6 of 21 cases surviving, compared with 4 of 9 cases having symptom-duration of more than the 12 months. But as shown in Figure 8 there is no great correlation for individual cases. For astrocytomata there is greater individual variation between cases, the symptom-duration periods for grade 1 tumours being 3 to 84 months, for grade 2,

3 to 276 months, and for grade 3, 4 to 30 months. If for the astrocytoma group we select 12 months' history and 3 years' survival as test periods, we find 5 of 12 cases with short histories and 5 of 13 cases with longer histories surviving. The lack of correlation in individual cases is again shown in Figure 9. For the general group of supratentorial gliomata there are similar great variations in symptom-duration (such as 3–96 months for oligodendroglioma, 3–96 months for unspecified glioma and 1–96 months for clinical glioma) and no great correlation with survival. Thus, while a long period of symptoms *may* be associated with prolonged survival, it is not necessarily

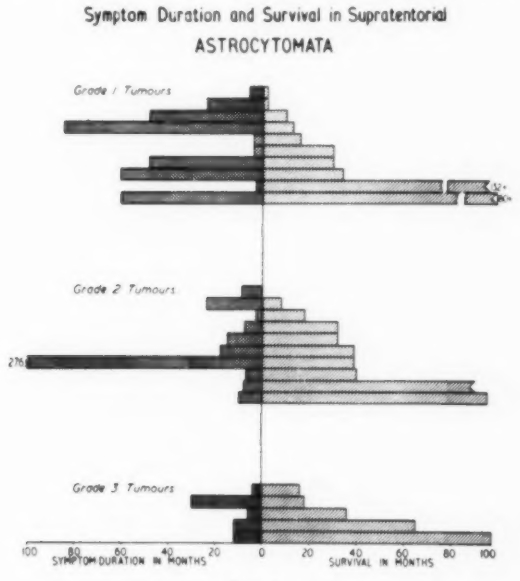


Fig. 9.

so, as so many factors other than the time and efficacy of treatment are concerned. We have already seen that the natural history of a glioma can only be fully assessed in retrospect, and the parameter of time involves pre- and post-treatment portions. Penman and Smith (1954) concluded that the "survival period after the onset is a more significant feature than either of its component parts". Netsky, August and Fowler (1950) suggested that in reporting results the survival from the first symptom, as well as the postoperative survival, should be given. While the importance of the two parts of the time-parameter is well recognized, it must be stressed that they should be separately stated because of potential inaccuracies in history assessment which may vitiate comparisons of results.

Site. The limitations of any analysis of prognosis according to site of tumour are obvious. While separation of supra- and infra-tentorial gliomata is valid (even for glioblastoma multiforme), within the cerebrum itself many tumours transgress the boundaries of the main lobes. Of 30 cases of glioblastoma multiforme there was no significant difference in mean survival for frontal (18.8 months), parietal (21.5 months) and temporal (18.3 months) lesions. Similarly there was no difference in mean survival (43 months) of 25 cases of cerebral astrocytoma as between frontal and parietal regions. Most strikingly, of the cases of "clinical glioma" those arising in the posterior third ventricle ("pinealoma") had a much longer survival (median 60 months) than those of the hemisphere (median 19 months).

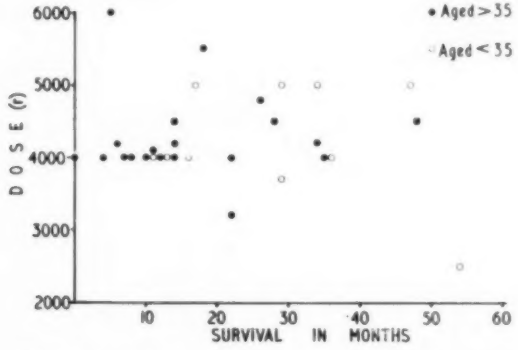


Fig. 10. Radiation dose and survival in supratentorial glioblastoma multiforme.

Parameters of radiotherapy

Radiation dose. Over the period of 17 years (1937–1953) the radiation doses employed have varied considerably, but they have not been selected because of the degree of malignancy of the individual tumour. Rather have they reflected the current conception of the radiation tolerance of normal brain, the highest doses having been given in the earlier days. The tumour doses lay mainly between 3,000 r/25 days and 6,000 r/42 days, the majority (62 cases) receiving 4,000–5,000 r. Doses of under 3,000 r (4 cases) indicated failure to complete the prescribed course. Seventeen patients received 5,000–6,000 r, and only 11 over 6,000 r.

The effect of the patient's age on survival (younger patients surviving longer) is so potent a factor that it must be considered in any analysis of radiation dose effect. Of the 30 cases of glioblastoma multiforme, 22 received 4,000–5,000 r and only 5 over 5,000 r. In Figure 10, dose and survival are charted, and patients over the age of 35 are distinguished from those of younger ages. It is apparent immediately that youth is a

more potent factor than the radiation dosage in promoting prolonged survival in those cases. All seven cases with dosage of more than 4,500 r were under 45 years (and four were aged less than 35); similarly, two of the three cases with dosage under 4,000 r were young, and the case which received only 2,500 r was re-treated later. Any apparent effect of longevity being associated with high or low dosage may thus be explained entirely on the basis of age of this group. The age effect for other supratentorial gliomata is less marked and permits of more detailed analysis. Taking the whole group of supratentorial glioma with the exclusion of glioblastoma multiforme (i.e. proven and clinical glioma) we find that 3 cases received less than 3,000 r, 6 between 3,000 and 4,000 r, 40 between 4,000 and 5,000 r, 12 between 5,000 and 6,000 r, and 10 over 6,000 r. On charting

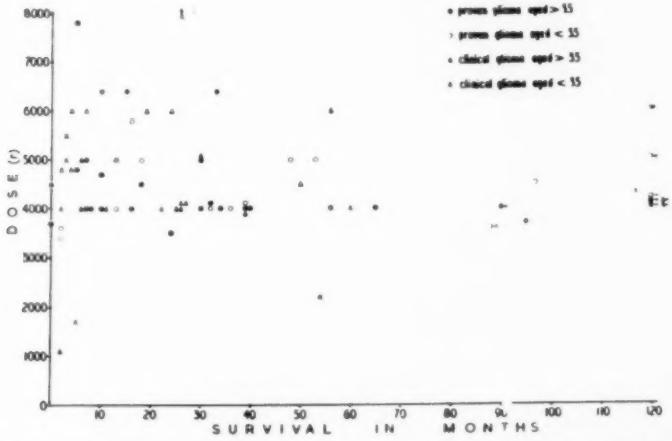
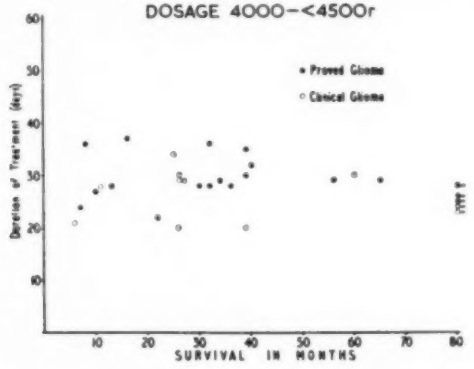


Fig. 11. Radiation dose and survival in supratentorial glioma (excluding glioblastoma multiforme).

radiation dose and survival for this group (Fig. 11) the impression is that (apart from the very low doses) increased dosage may be associated with a lower survival rate. If the two-year survival rate is compared for the group receiving 4,000–5,000 r with that for the cases receiving over 5,000 r, we find 63 per cent. surviving in the lower compared with 41 per cent. in the higher dose range. Similarly, if the survivals of those cases receiving exactly 4,000 r (29 cases) are compared with those receiving more than 4,000 r (34 cases), a higher survival rate is observed in the former group. The difference is still apparent on analysing the younger (under 35) and older (over 35) patients separately; from Figure 11 it is seen that none of the older survivors had high dosage. It is, however, doubtful if these differences carry statistical significance. More important is the

heterogeneous nature of this supratentorial glioma group ; while such an assembly is necessary for statistical analysis to discern any marked correlations, one is very much aware, when the differences revealed are not great, of the possible effect of diversity of tumour types.

Overall duration of treatment. The total duration of treatment was, of course, closely linked with the magnitude of radiation dose: in fact, the dose-time relationship is really a single parameter. For a tumour dose of 4,000 r the overall time was usually 28 days; and in the minority of cases receiving 5,000–6,000 r the time was usually 35–42 days. However, because of the patient's clinical condition (necessitating reduction or



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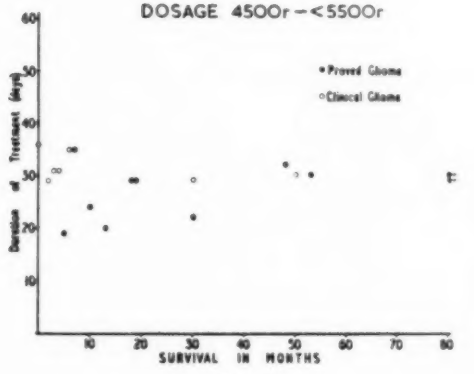

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Fig. 12. Overall treatment time and survival in supratentorial glioma (excluding glioblastoma multiforme).

omission of daily fractions) the overall time was sometimes prolonged out of proportion to the dose. In analysing the survival of glioblastoma multiforme any effect of prolongation of treatment is overshadowed by the age effect. In the other supratentorial gliomata, however, we can for a given dose examine the effects of prolongation and reduction in overall time. Thirty-one patients received 4,000–4,500 r, and when the treatment was given in less than 30 days, 6 out of 21 cases survived over 5 years, compared with 1 out of 10 cases when the time exceeded 30 days (Fig. 12). On the other hand, in the higher dose range, a number of the earlier cases was treated in a short time (i.e. more than 1,000 r per week). Of 18 cases receiving 4,500–5,500 r, equal numbers were treated in less than 30 days and in more than this period. Only 1 of 9 treated in the shorter period survived 3 years, compared with 4 of 9 over the longer time.

The prolongation of treatment time in the 4,000–4,500 r group was usually due to deterioration in the clinical state from the effects of the tumour, and the poor results cannot necessarily be related to the dose-time relationship. In the higher dose group, however, the *reduction* in treatment time was a planned measure, and the less good results may be an indication that a rate of 1,000 r per week should not be exceeded if proceeding to these high doses.

Radiation intensity. The X-ray dose rate in this series was 40 r/minute at the surface, for a field area of 100 sq. cm. at 100 cm. F.S.D. For a short period in 1944–1945 a trial was conducted with a higher dose rate of 200 r/minute, but only two intracranial tumours were irradiated. However, the clinical history of both cases is remarkable.

Case 1. Male *aet.* 33. Three years' history of right-sided Jacksonian epileptic attacks; and progressive right hemiparesis and dysphasia of six months' duration. At exploratory craniotomy on 26th November 1944, a deep infiltrating tumour was found at a depth of 4½ cm. in the left parietal region; the appearance was typical of glioma, no biopsy was performed and the flap was replaced. (Index: clinical glioma.) Million volt X-ray therapy instituted on 20th December 1944, by two opposed fields at 205 r per minute, was discontinued after a tumour dose of 2,150 r in 22 days because of the increased dysphasia and brisk skin erythema. Six days later, following an epileptic attack, the patient became comatose, and remained so until he was transferred to a chronic hospital three weeks later. Gradually consciousness was regained, and over the next six months his condition and the right hemiparesis improved. He left hospital, and by June 1946 was back at work as a printer's reader. Moderate degree of hemiparesis persisted, but the dysphasia had improved remarkably. He remained at work for *nearly three years*, but in March 1949 concentration became impaired, dysphasia increased, and he died on 25th July 1949; no autopsy was obtained. Survival 54 months.

Case 2. Male *aet.* 32. Six months' history of epilepsy, visual impairment for two months and headache for one week; signs of left temporo-parietal tumour confirmed by ventriculography. Exploratory craniotomy on 17th October 1942 revealed a tumour 3 cm. deep to the posterior end of the left Sylvian fissure. Million volt X-ray therapy in November 1942—tumour dose of 2,500 r/12 days at 40 r per minute. Six months later the patient was well, fit free, and working as a storekeeper; and remained at work until December 1944, when dysphasia, right hemiparesis and hemianopia appeared. Re-treatment was carried out in January 1945 by 1 MeV X-rays, this time at 200 r per minute, but was abandoned after 1,700 r/13 days because of deterioration,

with increased dysphasia and incontinence. Gradually his condition improved over three months, so that he was once again able to return to work, at which he remained until November 1946. The patient died on 20th March 1947, and autopsy showed glioblastoma multiforme extending into the right hemisphere. Survival 54 months.

Both these patients were young, and presented with focal epilepsy, so that the long survivals of 54 months are accountable apart from irradiation technique. But both showed dramatic reaction to low radiation dosage at high intensity (200 r.p.m.) and recovered to return to economic work. Variations of response to different dose rates in this range are not recognized clinically although radiobiological evidence suggests that they may exist. It is interesting that the only two cases so treated reacted dramatically, and suggests further investigation.

Volume irradiated. Interest in what may be termed the " latent extent " of gliomata and the effects of radiation on normal brain raises the question of whether survival rates may be related to the volume irradiated. The difficulty is that the actual extent of the lesion at time of treatment is usually not known precisely, and therefore the proportional coverage is hypothetical. The cases have been divided into those treated by " large " fields and those by " small ", on the arbitrary basis of whether the largest projection of the treated volume is greater than 120 sq. cm. (a figure selected by considering the usual sizes of gliomata at autopsy). Further subdivision concerned whether the fields were " opposed " or " angled ", as obviously most cerebral tissue is irradiated by " large opposed " fields and least by " small angled " fields. Of the 102 cases of supratentorial glioma, 59 were treated by " large " and 43 by " small " fields; the large fields were usually " opposed " (40/59) while the small fields were usually " angled " (31/43). The proportion between the various tumour types and dosage levels was relatively constant. The figures have been examined with respect to relief of symptoms, and to survival for periods of more than one year and more than three years. Only 25 of 59 cases treated by " large " fields were relieved of symptoms at six months, compared with 27 of 43 " small " field cases. Thirty-eight of the 59 " large field " cases survived more than one year, and 15 more than three years; but 32 of the 43 " small " field cases survived over one year and 13 over three years. In each respect the " small " field cases fared better, but on examining the individual case records it is obvious that what we are measuring is the effect of tumour size rather than volume of normal brain. The field sizes are so apparently related to the radiotherapist's concept of the extent of the lesion that any investigation of brain-sparing effect is vitiated: all that these figures confirm is that patients with small tumours fare better.

Individual supratentorial tumour species

Proceeding from these general considerations to study the effects of irradiation on individual types of supratentorial tumour, it is appropriate to go from the less to the more malignant varieties.

Astrocytoma. The astrocytomata vary in malignancy from the well-differentiated (grade 1) tumours, often of long clinical evolution, through various degrees of anaplasia to the relatively undifferentiated tumours of grade 3. Those which are frankly anaplastic (grade 4) have other features and are synonymous with glioblastoma multiforme; they have such characteristic behaviour that they must be separately considered. Discussion of the 25 cases labelled "Astrocytoma" in this series therefore concerns tumours in grades 1–3.

Of the 10 tumours of grade 1, nine arose in the hemispheres and one in the third ventricle. The patients' ages varied from 11 to 50 years (average 32.4); the symptom-duration from 3 to 84 months; and the post-treatment survival from 2 to 180+ months (median 23, average 44.9 months). Two patients are still alive 132 and 180 months after irradiation.

The radiosensitivity of these well-differentiated tumours has long been questioned; and it is difficult to assess, when the natural history may be prolonged, and when nearly all patients had partial surgical excision of their tumours.

Thus, the history of a secretary, who was able to return to work in a solicitor's office after surgery and irradiation, and survived 30 months, is only evidence of the absence of any ill effect of the radiation dosage (4,000 r in 28 days). Evidence of beneficial radiotherapy is, however, afforded by one case (3) of left frontoparietal astrocytoma in a man of 29, with a five-year history of epilepsy and two years of increasing headache and hemiparesis. Partial excision of the tumour was performed in 1942, but a year later headache recurred, with increasing hemiparesis. Following X-ray therapy in 1944 (tumour dose 5,000 r/30 days) there was slow improvement. The patient is alive 15 years later, though partially disabled by spastic hemiparesis.

The response in this case was in a postoperative recurrence, and indicates unusual radiosensitivity of a grade 1 astrocytoma. Even if the recurrence after surgery was due to development of anaplasia in the residual tumour, the prolonged period of survival (15 years+) implies a therapeutic effect on the original tumour residue.

Ten tumours were of grade 2, and the patients' ages varied from 29 to 59 years (average 44.6); the histories varied from 3 to 276 months and the survivals from 0 to 90+ months (median 35.5 and average 39.3 months). In this grade, clinical evidence of radiosensitivity emerges more clearly, although the factor of partial surgical excision often operates. For instance:

Case 4. A man of 48, with an eight-month history of headache and epilepsy, had a partial removal of an infiltrating tumour of the left frontal lobe. The growth invaded the corpus callosum and visible tumour was left behind at operation. Histologically the astrocytoma was mainly well differentiated, but some areas showed increased cellularity and pleomorphism (grade 2). Three months after X-ray therapy (tumour dose 4,000 r/28 days) the patient was symptom free and started work as a garage cleaner. He is now well, free from symptoms and signs, and working in a radio factory, eight years after radiotherapy.

The tendency of grade 2 tumours to further de-differentiation tends to cloud the evidence of radiotherapeutic response.

This is exemplified by the case (5) of a man of 29 having a left temporal astrocytoma which biopsy showed to be a grade 2 tumour. No excisional surgery was undertaken, and after X-ray therapy (tumour dose 4,000 r/35 days) his dysphasia improved. He returned to work loading provisions, but because of persistent epilepsy he eventually became a dustman. He died after a brief illness 39 months after irradiation, and the tumour was found to be mainly a glioblastoma multiforme with some areas of astrocytoma. It was not possible to say whether they had initially coexisted. While symptomatic response had been obtained by irradiating the original tumour, radiotherapy had not prevented its de-differentiation into glioblastoma.

Only five tumours were classified as grade 3 astrocytomata, the patients' ages varying from 27 to 59 years (average 41.6). The pre-treatment histories were much briefer than in the better differentiated tumours (4 to 30 months, average 12 months), but the patients had relatively long survivals (16 to 97 months, average 46.4 months); there was no correlation between symptom duration and survival. These features, together with the clinical response, suggest a considerable degree of radiosensitivity for grade 3 tumours.

In one case the radiotherapy was given (without benefit) for a recurrence a year after surgery; but in the other four cases all the patients returned to work. A housewife aged 56, treated by biopsy of left parietal tumour and radiotherapy, remained well (with regression of dysphasia and pyramidal signs) for four years, but succumbed 65 months after irradiation. A man of 34 had a partial removal of a temporal tumour, followed by irradiation (4,520 r/29 days). He returned to work as a sheet metal worker and was well for eight years, when he died after a brief illness of stupor devoid of localizing features. Autopsy revealed active tumour at the operation site; but also, and quite separately, similar growth in the contralateral hemisphere, and it seems likely that this grade 3 astrocytoma was a multicentric neoplastic process.

When we review the experience of radiotherapy in these three grades of astrocytoma, and compare the symptom-durations and survivals, we find that it is hard to discern evidence of radiosensitivity in grade 1, but some grade 2 tumours are responsive; and in this small series the majority of patients with grade 3 tumours have benefited. The response in grade 3 astrocytoma has been irrespective of age, and it appears that the favourable factor is a degree of anaplasia short of that associated with the sinister picture of glioblastoma multiforme.

Glioblastoma multiforme. The natural history of glioblastoma multiforme is in some ways more uniform than that of other supratentorial gliomata: it is a frankly malignant tumour which, untreated, progresses relentlessy to the patient's death after a relatively short course. Penman and Smith (1954) record that 76 of 163 cases died *within a month* of admission to a neurosurgical unit. While this is typical of the glioblastoma

sui generis, a proportion of cases arise by de-differentiation in astrocytomata; it is uncertain at what stage such de-differentiation occurs, and also, from biopsy material, in what proportion of tumours. To this extent a series of glioblastomata may represent a mixture of neoplastic processes. Cases arising by de-differentiation are likely to have a longer pre-treatment history, much of which would be due to the astrocytoma. *In reporting results of glioblastoma it therefore becomes important to include the symptom-durations as one clue to the biological composition of the series; the other important clue is, as we have already seen, the age-distribution.*

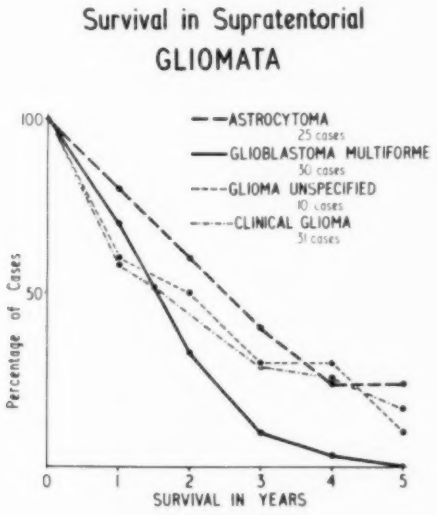


Fig. 13.

Of the 30 cases of proven supratentorial glioblastoma multiforme, 19 were male and 11 female; the ages varied from 18 to 62, the average being 39.4, and the median 40 years. The pre-treatment symptom-duration varied from 2 to 24 months for 27 of the 30 cases; but the other 3 had histories of 72, 108 and 120 months. The two with longest histories later afforded histological evidence of pleomorphism in the tumours—areas of fibrillary astrocytoma adjoining the typically malignant changes of glioblastoma multiforme—supporting an origin by de-differentiation.

The curve of survival (Fig. 13 and Table IV) represents a gloomy picture. Of the 30 cases, only three were alive at three years and none survived for more than five years. Although median survival is 15.5 months, the average is 19.7 months. Nine cases died in the first year

(six of them after six months), and 11 survived between one and two years; of the three cases alive at three years, two died in the fourth year and one in the fifth. In glioblastoma multiforme the variable factors of case selection for radiotherapy, age composition of the series, and the proportion of de-differentiated astrocytomata irradiated, make one very hesitant about comparing results in different series. Without drawing any conclusion, therefore, we may mention the average survivals in some other series. Craig, Dodge and Svien (1957) recorded an average post-operative survival of 6.6 months in 54 cases of grade 4 astrocytoma (of average age 42.6 years). Netsky, August and Fowler (1950) recorded their survival times from the *first identifiable symptom*, and found the average in 70 cases to be 17 months. Of their 57 patients treated surgically 35 received postoperative radiotherapy and had an average duration of disease of 27 months (median 13.1 months). Again, Davis, Martin, Goldstein and Ashkenazy (1949) found only 11 cases to have survived more than two years, out of 187 operated cases in a series of 211 patients, and the longest survival was 41 months.

When we proceed from numerical analysis to the clinical picture there are shafts of light even in glioblastoma. Although there is considerable variation, there can be no doubt that many of these tumours are moderately radiosensitive, as shown by the following case:

Case 6. A man aged 39 presented with a three-month history of severe headaches, but recalled that for 14 months he had had occasional "blackouts". The signs of very high intracranial pressure were shown by ventriculography to be due to a right temporo-frontal tumour, which on craniotomy was found to be an extensive glioma. Apart from biopsy (histology: glioblastoma multiforme) no surgery was undertaken, and the flap was replaced without decompression. A course of 1 MeV X-ray therapy was given (tumour dose 4,500 r in 28 days) and at the end of treatment headache had abated and papilloedema had almost completely subsided. Six months later he was symptom-free and had returned to work as a plasterer; except for pallor of the optic discs there were no abnormal signs. 18 months after radiotherapy he was still at work and free from headache; vision was normal despite consecutive optic atrophy, but slight memory impairment had occurred, and the left plantar response was now extensor; occasional epileptiform attacks responded to phenobarbitone. In the following six months vision and memory deteriorated, inco-ordination of the left hand supervened, and he died after a short illness, 28 months after radiotherapy.

In this case of glioblastoma multiforme (aged 39, symptom-duration 14 months, no excision, survival 28 months), the evidence of radiosensitivity is based on the relief of raised intracranial pressure. In the following two cases, also without excisional surgery, it is based mainly on relief of focal signs.

Case 7. A man aged 39 presented with a 13-month history of epilepsy with uncinate aura, hypersomnism, and weakness of the right arm. Radiological investigations revealed a left fronto-temporal tumour, with little evidence of raised pressure. Following a course of 1 MeV X-ray therapy (tumour dose 4,000 r in 22 days) his condition improved in that he was less drowsy and the right arm was almost as strong as the left. At the end of three months he was free from fits or drowsiness (but receiving anti-convulsants)

and had no limb weakness. He returned to work as a carpenter and remained well for 18 months after treatment, after which drowsiness and hemiparesis recurred, and he died 22 months after irradiation. At autopsy the tumour was a typical glioblastoma multiforme.

Case 8. A woman aged 33 had a three-month history of dysphasia, focal epilepsy and, one month later, of headache. Clinically the patient had a moderate nominal and expressive dysphasia, dysgraphia, and slight weakness of the right arm and foot; there was slight papilloedema. A left fronto-parietal tumour was revealed by carotid angiography, and ventriculography, and burrhole biopsy confirmed it as a glioblastoma multiforme. A course of 1 MeV X-ray therapy (4,000 r) was prolonged to 35 days because of episodes of headache and increased drowsiness. Six months later the patient had no headache and her speech was improved. While there was slight slurring, no dysphasia was demonstrable on formal testing. The optic fundi were normal, and no long tract signs could be elicited. She remained well, doing her housework and some needlework, for over a year, until dysphasia, hemiparesis and headache with papilloedema supervened over a period of three months. 26 months after the initial course of radiotherapy, further X-irradiation was carried out (tumour dose 3,000 r/33 days) with moderate response—so that three months later there was no headache, no dysphasia, but the long tract signs persisted. However, the patient died 36 months after the first course of X-ray therapy.

When the patient has undergone partial excision of the tumour it is more difficult to assess on clinical grounds the role of postoperative irradiation. The following case may be cited briefly as an example of benefit from irradiation in such circumstances.

Case 9. A girl of 23, with a six-month history of headache, had a partial excision of a left frontal tumour (glioblastoma multiforme); and postoperative 1 MeV X-ray therapy—tumour dose of 5,000 r/30 days. A year later she had returned to economic work as a shop assistant, and remained well for nearly four years. After a short terminal illness of epilepsy and coma she died 47 months after treatment, and autopsy revealed recurrent left frontal tumour invading the floor of the anterior fossa.

The factor recognized as predisposing to such a favourable therapeutic response is the relative youth of the patient. Not only do younger patients with glioblastoma live longer; in this series it is shown that they respond more favourably to irradiation.

Despite such satisfactory effects, it is clear that the response of glioblastoma to irradiation is usually but transient. In this series, no case submitted to autopsy examination has been found free from growth. The autopsy finding of extension into the opposite hemisphere through the corpus callosum (the so-called " butterfly " distribution of glioblastoma) is sufficiently frequent to demand an appropriate radiotherapeutic technique. However, the cause of failure after clinical remission was regrowth of radioresistant elements rather than incomplete coverage of the tumour during irradiation. The essential problem is the lack of radiosensitivity of glioblastoma.

Histology suggests a dual mechanism for such radiosensitivity as glioblastoma may possess. For in addition to the inherent sensitivity of the tumour cells, another process can act. " The multiformity of histological appearance is due not only to variations in the form of the neoplastic cells, but also to widespread degenerative and reparative changes "

(Bailey, 1948). Part of the pathological picture produced in glioblastoma by irradiation resembles an intensification of the usual degenerative changes. The spontaneous secondary changes particularly affect the blood vessels, and telangiectatic and hyperplastic vessels were noted by Virchow (1865) as part of the tumour process. Gough (1940) described three types of vascular change—new vessels forming in the coat of an existing vessel, new glomerulus-like outgrowths, and ingrowths of endothelial cells to subdivide the original lumen. They appeared to be a reaction on the part of the blood vessels to the presence of new growth. While not specific for glioblastoma, such changes are much commoner in association with this tumour. Scherer (1940) pointed out that such an angioblastic proliferation may not only precede the growth of the tumour, but grow from uninvaded tissue towards the tumour edge. Attempting to correlate such changes with the clinical data, Davis *et al.* (1949) divided their tumours into an angiothrombotic group (showing microscopic evidence of thrombosis, and multiple large areas of infarction and haemorrhage), and an angioproliferative group; they found the survival time to be usually longer for the latter. This vascular hyperplasia may be of such intense degree as to resemble an angioma. It is clear that in glioblastoma we have an effect akin to the "stromal reaction" which epithelial neoplasms may produce in the tumour bed. The importance of the effect of irradiation on this stromal response, and the resulting "indirect action" of radiation, is well recognized in radiotherapy. Moreover, the vessels concerned in the angioblastic proliferation in glioblastoma are of the calibre and development to be highly radiosensitive. The possible radiotherapeutic importance of the vascular proliferations is that (*a*) they represent a host response to the development of the tumour, (*b*) they may be partly responsible for early reaction to irradiation, (*c*) the effects of irradiation may be dose-rate dependent, (*d*) the increased vascularity increases oxygenation and enhances radiosensitivity of the tumour in the early stages of radiotherapy, but (*e*) once the vessels become thrombosed, although tumour infarction and necrosis may ensue, the residual tumour is left less radiosensitive. It therefore seems likely that for further advance in the radiotherapy of glioblastoma, particular attention must be paid to such vascular phenomena.

Oligodendroglioma is a relatively uncommon tumour arising in the cerebral hemisphere, with a reputed predilection for the occipital lobe; typically of slow evolution, it is often calcified. In this series there were five cases: two of frontal, one parietal, one parieto-occipital, and only one of truly occipital origin. Four patients were male and one female; their ages differed little—from 43 to 56 years. The symptom-duration, however, varied from 3 to 96 months, and the survivals from 2 to 123 months. The three cases with short histories, 3, 4 and 10 months, survived for only 15, 10 and 2 months respectively, while those with histories of 36 and 96 months survived for 56 and 123 months. Since four of the five

patients had partial excision of the tumours, no conclusion concerning postoperative irradiation can be drawn. The longest survivor (123 months) returned to full clerical work for 10 years and the terminal illness was of only one month's duration. There is evidently great variability in the behaviour of oligodendrogliomata. Bailey and Cushing (1926) gave the period of postoperative survival as "four years plus"; but Shenkin, Grant and Drew (1947) recorded the average period as less than two years, while Davis, Martin, Padberg and Anderson (1950) found that it varied in 24 cases from 1 to 288 months (mean 49.7 months). In this tumour even 10-year survival rates may not be absolute.

Glioma unspecified. In this group of 10 cases histological verification had been obtained of the gliomatous nature of the tumour, but no specific label was appended; these were mainly earlier cases, often referred from other hospitals during the war. Except for one case discussed below, the ages varied from 29 to 58 (average 39) and the symptom-duration from 3 to 96 months. The mean survival was 41.7 months; three patients were alive at three years and one survived more than five years. The longest survivor was a case of *glioma of the optic chiasm.* This patient (case 10), a girl of 10, presented in 1941 with severe visual impairment and polydipsia, and at exploratory craniotomy the tumour was firmly attached to the undersurface of the right optic nerve and chiasm. X-ray therapy (tumour dose 4,000 r/25 days) was followed by some visual improvement, but the patient remained disabled by optic atrophy and polyuria. She is alive, although handicapped, 18 years later. Taveras, Mount and Wood (1956) have pointed out that radiotherapy is the method of choice in the treatment of glioma of the optic nerve and chiasm, and 15 of their 19 patients survived for more than five years.

"*Clinical glioma*" *group.* The 31 cases in this group were those in which histological confirmation was lacking although the clinical picture, special investigations, and subsequent course indicated a variety of supratentorial glioma to be the true diagnosis. Some cases had, of necessity, only radiological investigation (ventriculography or arteriography) and these will be discussed later; a number had exploratory craniotomy, but the tumour found was extensive or deep, or the biopsy unsatisfactory. The patients formed a more heterogeneous group than the others. The ages varied from 12 to 63 (average 35.3) years, and the symptom-duration from 1 to 96 months; the average survival was 35.1 months. The median survival (24 months) is, at first sight, nearer to that of glioblastoma multiforme than to those of the other supratentorial tumours. Closer inspection, however, shows that, while the number of early deaths is high (the numbers being reduced by almost half in the first year), the proportion of long survivals (26 per cent. at four years) is also high and suggests that only a minority were in fact glioblastomata. In view of

this heterogeneity, interest in this group is centred particularly on the clinical syndromes encountered. The most important is that associated with tumours of the posterior part of the third ventricle.

Posterior third ventricular ("pineal") tumours. Tumours arising from the pineal are rare, and they produce their characteristic symptomatology by compression or invasion of normal brain structures. The tumour lies between the splenium of the corpus callosum above, the brain stem below and the cerebellum behind, and protrudes into the third ventricle. As the tumour mass increases in size it displaces the aqueduct and causes obstruc-

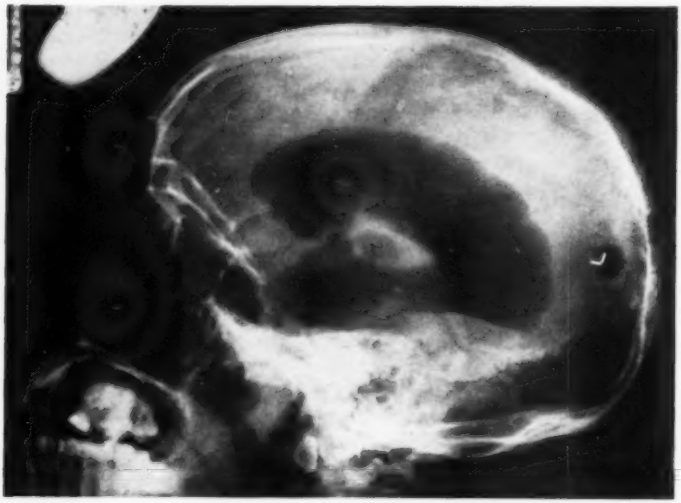


Fig. 14. Pinealoma. Ventriculograph showing gross dilatation of lateral and third ventricles, with filling defect at posterior end of third ventricle.

tive hydrocephalus of the third and lateral ventricles (Fig. 14); the neurological signs are due to disturbances of the oculomotor apparatus and of the pyramidal and cerebellar tracts; and ultimately the great veins of Galen become distorted. It is obvious that the characteristic syndrome is due to an expanding lesion at this crucial site, rather than to the specific nature of the neoplasm. Histologically, three groups of pineal tumour are recognized (Baggenstoss and Love, 1939): (*a*) those arising from neuroglial elements, the spongioblastic pinealomata, (*b*) those resembling developmental stages of the pineal, and (*c*) the pineal ependymomata. The spongioblastic pinealoma is usually referred to as the classic type (Kernohan and Sayre, 1952); its structure—of epithelial cells surrounded by loose

stroma containing many small lymphocyte-like cells—suggests its probable radiosensitivity. But ependymomata are probably equally common, and the undifferentiated ependymoblastoma may metastasize within the ventricular system.

Because of their situation such tumours are rarely amenable to surgical extirpation, and advance in treatment has come from two other directions. Firstly from the development of radiotherapeutic technique; and secondly from the introduction of the by-pass operation of ventriculo-cisternostomy by Torkildsen (1939). In this operation the hydrocephalus is relieved by the insertion of an acrylic tube between the posterior horn of the lateral ventricle and the cisterna magna; the relief of the hydrocephalic symptoms enables subsequent X-ray therapy to proceed relatively unhindered.

In this series six patients were treated for posterior third ventricular tumours, one by irradiation alone and five in association with Torkildsen's operation (performed by Mr. J. E. A. O'Connell). All were young, their ages being 12 to 26 years; three were male and three female. Four patients died, after 5, 26, 26 and 60 months, and two are still alive *after* 12 *and* 13 *years*. Histories of these cases are briefly appended.

(i) *Case* 11. Male, *aet*. 17, presented in 1941 with two years' history of diplopia, weight increase and somnolence, six months' history of frontal and left temporal headache, and six weeks' attacks of vomiting, with visual deterioration and right hemiparesis. On examination: head large (23¾ ins. circumference); obese body with female hair distribution, but normal genitalia; drowsy; high papilloedema with exudates; failure of upward gaze above horizontal, with bilateral weakness of abduction; pupils small, equal and inactive; right hemiparesis with hypertonicity and gross ataxia; bilateral extensor plantar responses. Ventriculography revealed gross hydrocephalus with obstruction between third and fourth ventricles and a filling defect of the posterior part of the third ventricle. The clinical and radiological features indicated a diagnosis of posterior third ventricular tumour, probably a pinealoma. The patient became comatose, and, when X-ray therapy was started two weeks after ventriculography, he was in a state of total de-afferentation, being completely quadriplegic, and with no intellectual or emotional responses. X-ray therapy (1 MeV), 7th October to 4th November 1941, lesion dose 4,450 r/28 days, was followed by a remarkable improvement, and a month later the patient was talking almost normally and starting to walk. A further course of X-ray therapy (4,300 r/18 days) was given in February 1942, and six months later the patient's only symptom was diplopia and inability to read; he was free from headache and could walk two miles. The failure of upward gaze persisted, and bilateral optic atrophy was noted. He remained well until July 1943, when vision deteriorated, right-sided ataxia recurred, and bilateral deafness supervened. X-ray films now showed extensive calcification of the pineal region. Gradual deterioration ensued, and the patient died in December 1943. Autopsy revealed a partly calcified mass extending from the pineal into the third ventricle, and presenting on the brain surface as a gelatinous mass at the tuber cinereum so as to stretch the optic chiasm; no evidence of dissemination; no histological studies. Survival 26 months.

(ii) *Case* 12. Male, *aet*. 26, presented in December 1946 with six weeks' history of severe headache, 10 days' amblyopia and diplopia, and weakness of the left arm and leg with ataxia. On examination: incapacitated by headache; V.A. R. 6/12 L. 6/18; bilateral papilloedema with exudates; pupils large, left light reaction sluggish, but convergence reactions normal; external ocular movements (including upward gaze) normal; slight left facial weakness and ataxia of left hand; reflexes normal. Ventriculography (Fig. 14) showed gross dilatation of lateral and third ventricles, with a pineal

defect in the posterior end. Ventriculo-cisternostomy was performed by Mr. O'Connell on 9th December 1946, followed by rapid reduction of headache, and 1 MeV X-ray therapy was given from 17th January to 24th February 1947 (lesion dose 6,000 r/39 days). Three months later the patient was very well and working as a clerk. He has remained well, the only abnormal signs being dilatation and sluggish reaction of the left pupil. Survival 154 months +.

(iii) *Case* 13. Female, *aet.* 25, investigated in February 1947 because of severe headaches of three months' duration. On examination: alert; slight neck stiffness; slight bilateral papilloedema; pupils unequal with poor light, but normal convergence reactions; external ocular movements full.

Ventriculography showed severe internal hydrocephalus with filling defect of posterior part of third ventricle. Ventriculo-cisternostomy performed on 5th March 1947, by Mr. O'Connell, resulted in relief of headache, but no change in the ocular signs. X-ray therapy (1 MeV) was given in April–May 1947 (lesion dose 4,000 r/30 days), and six months later the patient was well, having resumed full household duties, and except for pupillary inequality there were no abnormal physical signs. In January 1950 morning headaches recurred, and in July 1950 diplopia, drowsiness, depression, weakness of left arm and ataxia. (Skull X-ray films, however, showed recalcification of the posterior clinoids compared with the appearance before treatment.) Further X-ray therapy (3,000 r/28 days) given in August 1950 for the tumour recurrence resulted in improvement in headache and hemiparesis. Nine months later (May 1951) the patient was able to get about alone, but still diplopic. In January 1952 her condition deteriorated and she died in April 1952; no autopsy. Survival 60 months.

(iv) *Case* 14. Male, *aet.* 21, presented in 1947 with eight years' history of recurrent headaches, worse for the last seven months, and diplopia of seven months' duration; right tinnitus and ataxia occurred six weeks before admission. On examination: well covered, deficient growth of trunk hair, genitalia normal; neck stiffness; high bilateral papilloedema with exudate and haemorrhages. Large equal pupils, inactive to light and convergence; bilateral abducent palsy; failure of upward gaze; slight left facial weakness and postural droop of left arm.

Ventriculography showed internal hydrocephalus, with obstruction at the posterior third ventricle. Ventriculo-cisternostomy, performed on 18th October 1947 by Mr. O'Connell, resulted in relief of headache and also in improvement in external ocular movements (including upward gaze). 1 MeV X-ray therapy (lesion dose 4,000 r/22 days) was given in December 1947, and three months later the patient was free from headache, his vision continued to improve (read headlines) and he had started farm work. He has remained very well and now works as a petrol attendant; vision is good and no abnormal signs remain (external ocular movements and pupillary reactions normal). Survival 136 months +.

(v) *Case* 15. Female, *aet.* 24, presented in April 1951 with two months' history of headache and diplopia, attacks of tingling of the right arm and leg, and transient weakness of the right hand for one month, and hypersomnia for two weeks. On examination: alert; bilateral papilloedema; pupils dilated, reacting very slightly to light, but briskly to convergence; external ocular movements full; minimal right lower facial weakness. Ventriculography showed internal hydrocephalus with absent filling of posterior part of third ventricle and aqueduct. Ventriculo-cisternostomy was performed by Mr. O'Connell on 27th April 1951, with relief of headache and reduction of papilloedema, but the pupillary abnormalities remained. X-ray therapy (1 MeV) was administered in May–June 1951 (lesion dose 4,000 r/26 days). In August 1951 the patient was well, and the pupillary reactions had become normal. For the next year she remained well, with normal vision, and was able to go dancing. In March 1953 headache and diplopia recurred and increased, and a month later pupillary convergence was absent and right eye diverged. Retreatment by 1 MeV X-irradiation (4,100 r in 30 days) produced no improvement, and bilateral pyramidal and cerebellar signs, followed by generalized rigidity, ensued. The patient died in July 1953 after a period of hyperpyrexia and coma; no autopsy. Survival 26 months.

(vi) *Case* 16. Female, *aet.* 12. In this case of an obese little girl, mentally retarded, with two years' history of involuntary arm tremors, headache and visual deterioration, ventriculography showed gross obstructive hydrocephalus with defective filling of the

posterior third ventricle. Ventriculo-cisternostomy (20th February 1953) restored the C.S.F. circulation, but drowsiness and extensor rigidity persisted. X-ray therapy was discontinued after 1,700 r/27 days, because of the poor general condition, high pyrexia and difficulty of sedation. Spastic quadriplegia persisted, and the child died in September 1953. Survival five months.

Early assessment of the radiosensitivity of "pinealomata" is now rarely possible, owing to the immediate beneficial effect of Torkildsen's operation. This removes the fallacy of a great improvement in symptoms following a slight reduction in tumour volume at a crucial site. Caution is still necessary in interpreting later results of radiotherapy in the presence of ventriculo-cisternostomy. If the tumour is but slowly growing,

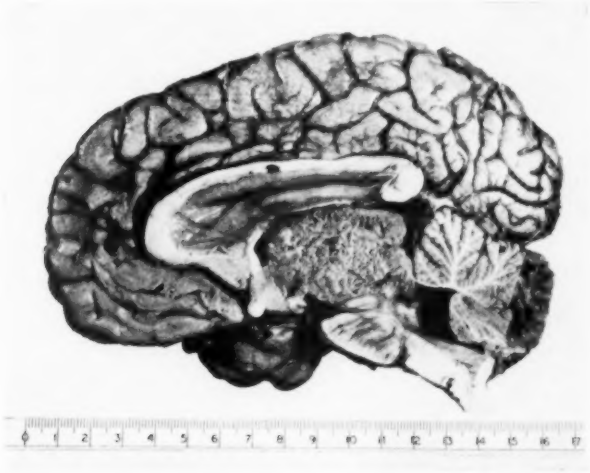


Fig. 15. Well-differentiated ependymoma of posterior end of third ventricle; ventriculo-cisternostomy alone produced complete remission of symptoms for four years.

symptoms may be produced only at the stage of aqueductal occlusion, and when this has been relieved by by-pass a further considerable period may elapse before midbrain symptoms supervene.

In a recent case (outside this series) ventriculo-cisternostomy had been performed in a woman of 30 with three years' history of increasing headache and recent ataxia; ventriculography (including myodil contrast studies) had revealed aqueductal stenosis with no evidence of tumour. Postoperatively there was complete remission of symptoms and signs (except for intermittent paresis of upward gaze). The patient remained well for *four years*, until headache, drowsiness and diplopia occurred over a period of three months. On examination she was almost stuporous;

there were no signs of raised intracranial pressure, but the picture of bilateral ptosis, inactive pupils, external strabismus, and bilateral paralysis of upward and downward gaze, with extensor plantar responses, suggested neoplastic invasion of the midbrain involving the quadrigeminal plate and reticular substance. The patient died of bronchopneumonia at the start of radiotherapy, and autopsy revealed a well differentiated ependymoma arising from the posterior third ventricle (Figure 15). It is nevertheless evident from the response in our first case, and the clinical course of the other cases, that these tumours are moderately radiosensitive. The two best results were obtained with doses of 4,000 r/22 days and 6,000 r/39 days; tumours given lower doses recurred and required re-treatment. The indication in " pinealomata " would appear to be for high dosage, provided that this can be given accurately to a relatively small volume of tissue, particularly sparing the cortex and subcortical white matter. These technical desiderata can now be achieved by supervoltage methods. We have, however, the paradox that as no biopsy is possible, the more efficacious the treatment the less we shall know of the nature of these rare tumours. Autopsy figures may in future reveal an increasing proportion of the more radioresistant tumours such as well-differentiated ependymomata.

II. INFRATENTORIAL GLIOMA GROUP

The infratentorial gliomata are essentially different in age incidence from those arising in the cerebral hemispheres, and because of differences of behaviour of even the equivalent tumour species they must be considered quite separately. The 22 cases in this series were made up (Table V) of

TABLE V

SURVIVAL PERIODS FOR INFRATENTORIAL GLIOMATA

Tumour type	*No. of Patients*	*No. alive >5 years*	*Survival in years* 0–¼	¼–½	½–1	1–2	2–3	3–4	4–5	5
Astrocytoma	6	6	–	–	–	–	–	–	–	6*(3+)
Glioblastoma multiforme	3	1	–	–	–	2	–	–	–	1+
Ependymoma	2	2	–	–	–	–	–	–	–	2+(1†)
Medulloblastoma	5	0	1	1	1	1	1	–	–	–
Glioma unspecified	3	2	–	1	–	–	–	–	–	2
Clinical glioma	3	1	–	1	–	–	–	–	1	1+

*Includes 4 patients who subsequently had surgical excision — 2 complete, 2 partial.
† „ 1 patient „ „ „ „ „ — complete.

astrocytoma 6, glioblastoma 3, ependymoma 3, glioma unspecified 3, and clinical glioma 3 cases; five cases were of medulloblastoma, which again requires separate attention for, although generically gliomatous, it has a very distinct pattern of behaviour and radiosensitivity. These variations within the group, and the small numbers, preclude statistical analysis and require individual consideration of each type of tumour.

Astrocytomata of the cerebellum are predominantly tumours of early life, mainly recognized in the first two decades; often circumscribed and frequently cystic; and infrequently tend to anaplasia (Russell and Rubinstein, 1959). Surgical excision is thus more likely to be successful than in the cerebral variety. The six cases in the present series varied in age from 9 to 30 (average 15) years; all had been surgically explored and found either inoperable or amenable to only partial excision. While all six patients survived for more than five years, four had surgical re-exploration and re-excision for recurrence of symptoms at intervals of from one to seven years after irradiation; two of these remain well. One girl aged 14 was found initially to have a right cerebellar astrocytoma which was inoperable because of the vascularity encountered. A year after X-irradiation (4,500 r/32 days) the tumour was re-explored and removed (being stripped from the surface of the midbrain); the patient, who subsequently married and had two children, remains well 12 years after the second operation. Of the two patients not re-explored, one is still alive after 161 months, and the other died after 114 months with astrocytoma still present. Thus, only one of the prolonged survivals in these well differentiated astrocytomata of the posterior fossa is directly attributable to irradiation, although in two others it partially facilitated subsequent surgery by diminishing vascularity.

Glioblastoma multiforme. This tumour is rare in the posterior fossa, but three examples occurred in this series, their ages being 7, 13 and 27, and the survivals 12, 84+ and 19 months respectively. In all three there was clinical evidence of radiosensitivity, and the longest survivor is of particular interest in that the tumour was a recurrence at the time of supervoltage X-ray therapy.

Case 17. A girl of eight complained in 1946 of neck pain and left hemiplegia of a few weeks' duration. X-ray therapy (200 kV) given at another hospital without exploration (tumour dose to posterior fossa 2,280 r/46 days) was followed by considerable symptomatic improvement and lessening of the hemiplegia. Four years later attacks of headache and vomiting occurred, and radiological investigation in 1951 at St. Bartholomew's Hospital now showed a large tumour of the fourth ventricle. Posterior fossa exploration was performed by Mr. O'Connell to reveal a large inoperable tumour of the cerebellar vermis invading the floor of the fourth ventricle and extending below the spine of the axis. Biopsy only was possible, and this showed the tumour to be a glioblastoma multiforme. X-ray therapy (tumour dose 3,000 r/34 days) was followed by gradual improvement, so that six months later the patient had abandoned her wheelchair and was free from headache or visual symptoms. Five years later (aged 18) she was well except for strabismus and slight weakness of the left leg; she both worked as a seed packer and cycled. Squint correction has since been performed and the patient is well over seven years after irradiation.

Even more than in supratentorial tumours, youth is an important beneficial factor in the radiotherapy of glioblastoma arising in the posterior fossa.

Ependymoma. Of the two cases of ependymoma of the fourth ventricle, one remains well eight years after incomplete surgical removal; but in

the other case there was no evidence of irradiation response, and at re-exploration two years later a complete removal was possible (the patient being alive 153+ months later). Incidentally, one patient with *papilloma* of the fourth ventricle (an inoperable vascular tumour lying on the medulla) is alive 194 months after irradiation.

Of the other infratentorial gliomata, mention may be made of a patient with a glioma of the dorsal surface of the fourth ventricle, who survived 106 months after irradiation, and in whom poorly differentiated astrocytoma (not medulloblastoma) was found at autopsy. Another patient (aged 50) with basicranial gliomatosis survived 139 months following radiotherapy, given after posterior fossa decompression and biopsy; while most cases of meningeal gliomatosis are related to an intramedullary medulloblastoma or glioblastoma, in this case no primary focus was discovered, and the possibility remains that some small primary tumour or a subarachnoid heterotopia (Kernohan) was irradiated with the meningeal disease. Of the two intramedullary brain stem tumours, one, arising in the pons, showed considerable transient radiosensitivity to 4,500 r in 136 days (the patient returning to work as a plasterer, but surviving only seven months); while in the other case radiotherapy was incomplete, and the survival four months.

The five cases of *medulloblastoma* were all advanced cases occurring in the early part of the series, and none survived more than three years. Present radiotherapeutic practice is the simultaneous irradiation of the whole cerebrospinal axis (e.g. Paterson, 1953) and our own method has been described (Jones and Innes, 1957).

III. NON-GLIOMATOUS TUMOUR GROUP

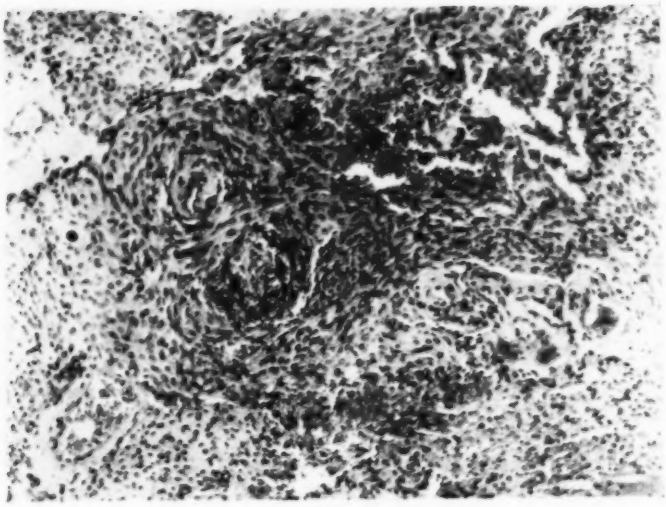
The intracranial tumours of radiotherapeutic interest other than the gliomata are meningioma and haemangioma, both of which are referred for irradiation only when inoperable by extent, site or vascularity.

Meningioma. Opinion on the radiosensitivity of meningioma has oscillated in the last 20 years between recognizing a moderate proportion as being radiosensitive, and a more recent view that radiosensitive examples should be regarded as angioblastomata rather than as true meningiomata. These tumours arise from the arachnoid, and, of the seven in the present series, two arose below the tentorium, the others being parasagittal (3), sphenoidal (1), and parasellar (1). It is difficult to decide the role of irradiation in promoting long survival when partial excision of a slowly growing tumour has been performed. Six of the seven patients lived for more than five years, the median survival being 98 months. Nevertheless, we have unequivocal evidence of radiosensitivity in at least two instances.

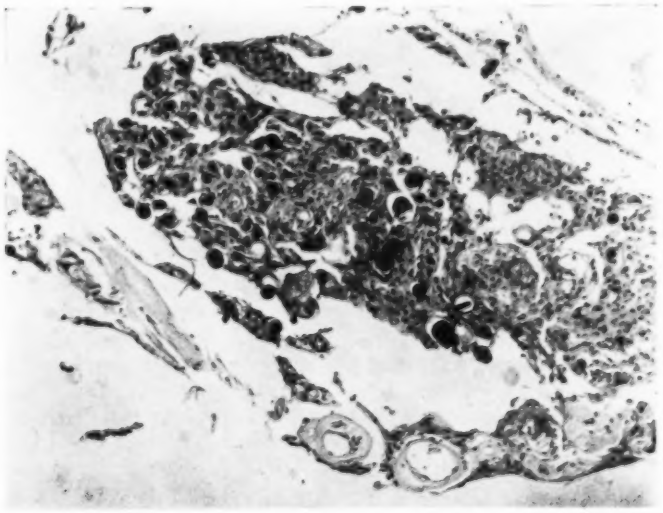
A man aged 33 had three years' history of impaired memory, followed by epilepsy and headaches, and at exploratory craniotomy a large left frontal parasagittal meningioma was inoperable because of its extent and vascularity. Following 1 MeV X-ray therapy (5,000 r/23 days) in 1943, the headaches gradually abated and the patient returned to work as a toolmaker. Epileptic attacks continued at intervals over the next four years, after which deterioration was noted. A further exploratory craniotomy was undertaken in 1948 and this time the tumour could be completely removed; however, the patient died of bronchopneumonia postoperatively. In another patient, X-ray therapy was given after partial excision of a parasagittal meningioma of the vertex, the histology having revealed malignant change. Following a tumour dose of 5,000 r/22 days the patient survived 123 months, but was incapacitated.

The most important, however, is a case (No. 20) in which we have both clinical and pathological evidence of radiosensitivity. The original tumour was an "angioblastic meningioma" (Figure 16 (*a*)), a vascular tumour shown after left frontal lobectomy to be extending posteriorly and medially under the falx and adherent to both optic nerves. Following irradiation (lesion dose 4,000 r/29 days) in 1948, the patient returned to work as a window cleaner and remained relatively well for seven years. Ultimately he developed a clinical picture of intellectual deterioration, headache, epilepsy and disorientation over a period of two years. Investigation in 1958 then revealed a space-occupying lesion of the *right* hemisphere which proved to be an *astrocytoma* unconnected with the previous meningioma. At autopsy, at the site of the initial lesion a little tumour could be recognized, and this was now shown to be a psammomatous type of meningioma with associated glial reaction (Fig. 16 (*b*)). This case demonstrates the radiosensitivity of angioblastic meningioma; and by the final picture of the transformed psammomatous residue proves that such tumours are truly meningiomatous and not merely angiomatous as has recently been suggested (e.g. by Kernohan and Sayre, 1952). It is evident that the main effect of irradiation on meningiomata occurs through the reduction in vascularity; this may control growth for many years and, most important, makes feasible further surgery of the tumour.

Finally, we consider the intracranial *angioblastoma*, which is usually an innocent tumour, but surgical excision may be impossible because of vascularity. The three cases in this series all occurred in the posterior fossa, and all showed clinical responses to dosage of between 3,000 r/15 days and 5,000 r/29 days. Symptoms recurred in one case after eight years, when total excision of the tumour was possible, and the patient is alive after 168 months; survivals in the other two cases are 72 months (cause of death uncertain) and 169+ months. Although these vascular tumours occurred in adults (aged 22 to 66), and the angiomatous tissue was by no means immature, the results of irradiation have been very satisfactory. The important principle in treating such cases is of course that the radiation dosage shall not exceed the tolerance of the normal brain.



(*a*)



(*b*)

Fig. 16. Effect of X-irradiation on meningioma. (*a*) Microphotograph showing angioblastic type of meningioma. (*b*) Section of tissue at site, nine years after radiotherapy, showing psammomatous bodies in tumour residue.

CONCLUSIONS

The objects of this investigation were to study the natural history of intracranial tumours under the influence of supervoltage X-irradiation, and to ascertain whether therapeutic results reflected the *a priori* physical advantages. A prolonged period of observation was necessary for the ultimate appraisal—as essential clinically as was high accuracy of tissue dosage throughout the physical determinations; fortunately, both these conditions obtained in this series. It is, of course, difficult to combine adequate numbers of uncommon tumours treated by uniform techniques with lengthy observation.

The main benefit of supervoltage irradiation is seen to be in the treatment of localized tumours of the posterior third ventricle (causing the "pinealoma" syndrome). The radiation dose necessary for cure is often above the tolerance of the normal cerebrum, but by the conflux of supervoltage radiation the potential damage to normal brain can be minimized. Other notably beneficial results have been in glioma of the optic chiasm, and in ependymoma.

Of the astrocytomata, although prolonged survivals occurred with grades 1 and 2, the greatest radiotherapeutic response is in those of grade 3; the beneficial factor being a degree of anaplasia short of the malignant picture of glioblastoma multiforme. But the volume of normal brain which must be irradiated lessens the special advantages of supervoltage therapy, although the patient still benefits from the diminished skin reaction.

In glioblastoma multiforme, a proportion of tumours are moderately radiosensitive, but the response is usually transient. The essential difficulty is in fact the lack of radiosensitivity of glioblastoma compared with that of normal brain. Youth is, however, often associated with comparative longevity, and young patients also respond better to irradiation. In reporting results, the importance must be stressed of stating the composition regarding age and symptom-duration as evidence of the character of the series.

Of the non-gliomatous tumours, there are important beneficial effects of supervoltage irradiation in inoperable meningioma and haemangioma, particularly in the posterior fossa.

The question of the *quality of survival* has not been mentioned. In the case of a young doctor with a fronto-parietal glioma, who returned to general practice for five years (and survived nearly 10 years in all), the quality of survival was self-evident. Similarly, in the case of a girl of 19, who, when treated 12 years ago for a hypothalamic tumour, was drowsy and cachectic, and now leads a busy life as a secretary, there is no doubt

that she has benefited in all ways from treatment. Such results are, however, quite exceptional. For the majority of patients survival is associated with greater or less affective and neurological deficit, even if economic work is resumed. But who are we to judge the emotional quality of survival? Hunter wrote that " in diseases the general character of the patient should be known, which is essentially necessary before we can judge of every symptom . . . for peculiarity of temperament will occasion great differences in the character of the disease ". Thus, judgment has to be exercised in deciding whether to offer an elderly patient with glioblastoma

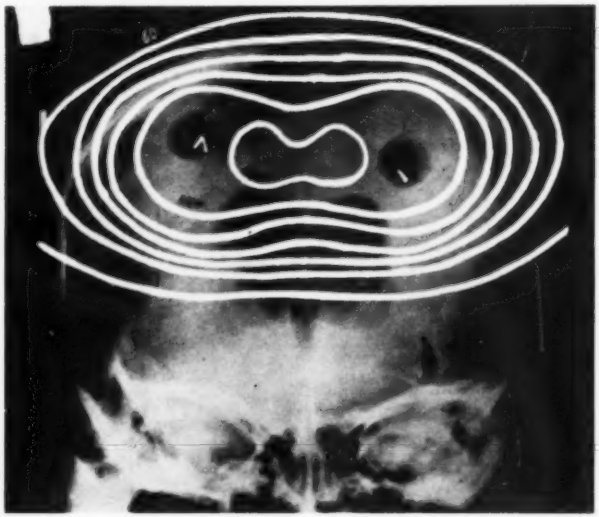


Fig. 17. Optimal radiation distribution for typical cerebral glioblastoma multiforme, obtained by arc-technique with radiocobalt telecurie unit. Two arcs of 220 [of 10 × 4 cm. field at 60 cm. S.S.D. with narrow penumbra. (Isodose superimposed on ventriculograph.)

the slight and transient benefit of radiotherapy; but the considerations will be quite different for a young patient with even a grade 3 astrocytoma. Having the maximal information available, each case must be judged clinically on its merits.

Radiotherapeutic technique has now reached the stage where almost any desired distribution of radiation within the brain can be achieved (Fig. 17). The fundamental and outstanding problem is the relative lack of radiosensitivity of the anaplastic astrocytomata, and particularly of glioblastoma multiforme. Progress is being made in " radiosensitiza-

tion " of many tumours (particularly by increasing their oxygen tension and by using chemical substances). Tumours of the glioma group offer a challenge in this respect. Because of the normally high oxygen tension of the brain, and the incidence of spontaneous necrosis in glioblastoma, it is likely that useful sensitization may be gained by " hyperoxygenation ". If such enhancement can be obtained in *young* patients, while by suitable fractionation of dosage retaining intact the stromal and vascular reaction to the tumour, further appreciable improvement seems likely. The other promising mode of attack is in combining supervoltage irradiation with localized chemotherapy of the tumour by carotid perfusion. If we can increase the differential effect, and maintain the integrity of nervous tissue, we may come nearer to Hunter's postulate for cure: " the alteration of the disposition . . . and not the destruction of the cancerous parts ".

ACKNOWLEDGMENTS

It is a pleasure to express my thanks to those who have made this investigation possible. To Mr. J. E. A. O'Connell for referring most of the patients, and for his constant guidance; to Mr. I. G. Williams for facilities for carrying on this work in the Radiotherapeutic Department; to Mr. Ralph Phillips, who began supervoltage investigation at St. Bartholomew's Hospital; to Mr. G. S. Innes and his staff for the dosimetry and advice on physical problems; to Mr. M. P. Curwen for statistical advice and assistance; to Dr. G. Canti, Dr. R. Cureton and Dr. A. G. Stansfeld for the microphotographs; to Mrs. E. S. Perkins and Miss Cripps of the Follow-up Department, who traced every patient; and to Mr. N. Harrison and the Department of Medical Photography for the illustrations. I am also indebted to Dr. L. W. Proger, Miss J. Dobson and Mr. J. L. Thornton for advice on the Hunterian sources.

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ANNUAL GENERAL MEETING AND SCIENTIFIC MEETING

7th December 1960

THE ANNUAL GENERAL MEETING of the College will be held on Wednesday, 7th December 1960, and it is hoped that this will be attended by as many Fellows and Members as possible. The scientific departments of the College will be open to visitors throughout the day, and there will be demonstrations on view illustrating the research work being carried out in the College on many and varied projects.

The Bradshaw Lecture will be delivered in the Edward Lumley Hall at 2.30 p.m. by Sir Stanford Cade, K.B.E., C.B., who has chosen as the title of his lecture " Malignant melanoma ".

This will be followed at 3.30 p.m. by the Annual General Meeting of Fellows and Members, after which tea will be available.

Any Fellow or Member wishing to submit a motion for discussion at the meeting is asked to notify the Secretary of the College, Mr. Kennedy Cassels, M.A., not later than 27th November.

SOME MEMORIES OF A FELLOW OF 1896

by

The Hon. Herbert A. Bruce, LL.D., M.D., F.R.C.S., F.A.C.S.

WHEN I ATTAINED my 90th birthday on 28th September 1958, I was the fourth oldest living F.R.C.S. Since then the grim reaper may have advanced my seniority.

Recently I have been reading the excellent history of the College written by Sir Zachary Cope and it has brought to life many memories of the years 1894–96 which I spent in London working for my Fellowship. It has been suggested to me that some of them be recorded and published in the *Annals* of the College.

Inspired by the late Dr. George Peters—the first Canadian to obtain a Fellowship in the Royal College—I decided to follow his example. After getting my medical degree from the University of Toronto in 1892 and serving as a surgeon on the C.P.R. steamship " Empress of India " on the Pacific, I was able to get a free passage to England by making myself responsible for the safe delivery of a rich young alcoholic to his home in Edinburgh after a world tour.

On arrival in London I presented my credentials to Mr. H. G. Hallett at the College. They were in order and I registered at the Medical School of University College on Gower Street. I was able to get a small single room at a boarding house in Brunswick Square, as well as three meals a day, for thirty shillings a week. Baths were a shilling each, extra.

After passing the conjoint examinations and qualified to practise I took a locum tenens position during my first summer vacation which enabled me to earn a little money. This post was in Woolwich, where I took over the work of a general practitioner, complete with his house, in which he had his office, and a horse and buggy to visit his patients. His office hours were from 7 p.m. to 10 p.m. Adjoining this office was a room flattered by the name " dispensary ". Here were four demijohns conveniently filled with suitable remedies for four common types of complaints. All one had to do was to make a quick diagnosis and write the number of the appropriate mixture on a piece of paper which the patient took with his bottle and had it filled. The charge for diagnosis and medicine was a shilling. The fee for driving and seeing patients in their homes was one and sixpence. This period gave me an interesting insight into the life of the people living in the East End of London. In the autumn I returned to my studies for the Fellowship.

At University College Hospital my chief teachers were Christopher Heath, Arthur Barker, Victor Horsley, Rickman Godlee, Rose Bradford, Professors G. D. Thane, E. A. Schäfer and Leonard Hill.

Heath's clinics were on general surgery. Before entering the operating room he would hang up his street coat in the passage way and put on an old frock coat—spattered with dried blood—which he kept exclusively for operating. Then he turned his coat cuffs back, immersed his hands in a one to two thousand solution of bichloride of mercury and started to operate. He was at least trying to follow the principles of antisepsis enunciated by Lister.

Before leaving for Canada, I called to say good-bye to Heath and thank him for his kindness to me. In my nervousness I must have put my foot on the bar of his chair, for which he rebuked me. It did not help the interview. However, I managed to express my appreciation and we parted good friends. To me it seems difficult to imagine that I was taught by a man who had served in the Crimean war. Heath was a dresser in the Navy before he took his M.R.C.S. in 1856.

I remember seeing Arthur Barker do one of his first operations under a local anaesthetic—the subcutaneous injection of a solution of novocaine—which method he had learned in Paris.

I was so attracted by Victor Horsley's work that I was almost inclined to specialize in brain surgery. However, before the turn of the century there was a greater field for general surgery in Canada. He was a brilliant teacher and surgeon and personally was very kind to me. I remember once he invited me to his house in Cavendish Square for luncheon. Unprepared, his wife seemed disturbed at seeing a guest and said, in front of me, that she had only enough chops for two and that he would have to share his with me! Sir Victor Horsley and his family stayed with me at my home when the B.M.A. met in Toronto in 1906. I can still see him lying at full length on the floor preparing charts showing the dangers of alcohol, which he used later at breakfast meetings. He was a most intemperate tea drinker, for it was served to him five times a day.

One of our outstanding teachers was Sir Rickman Godlee—the nephew of Lord Lister. He took us in comparative anatomy. My diploma bears his signature. When he was President of the College in 1913 and attended the opening of the American College of Surgeons, of which I was a founder member and Regent, our paths happily crossed again.

We took anatomy under Thane, physiology under Rose Bradford, histology with Schafer and laboratory work with Leonard Hill.

Albert Carless coached us in general surgery, which classes he held in his home. At the time he was revising the well known book on surgery by Rose, to which Carless later added his name. As students we went over the manuscript in minute detail and from time to time suggested changes to clarify the meaning. In fact, our small class felt that we should have been included as joint authors.

At the London Hospital, where I attended his clinics, I saw Frederick Treves do some of his early appendectomies among other operations. His name will always be coupled with his appendectomy on King Edward VII. Although appendicitis was by 1895 a recognized condition, the first operation for its removal had only been performed just eight years before, in Boston, by Dr. John Thomas Morton. During the entire time that I was studying medicine in Toronto I only saw one such operation.

At the Middlesex Hospital I saw the skilful work of Bland Sutton. He was a very human and understanding person, with great ability as a surgeon. No doubt he was aided by his early experience as a curator at the London Zoo, where he did post-mortems on the animals.

Once a week I went to a clinic at St. Bartholomew's, presided over by Mr. W. J. Walsham. All the medical staff participated in the clinic, which was conducted in the amphitheatre of the building. The patients were wheeled in and, before an audience of some 100 students, half a dozen doctors would discuss the diagnosis. This method we found most helpful in our work.

Percy Dean's outpatients clinics at the London Hospital drew men from all over London and he gave promise of being one of the leading surgeons of England. Unfortunately, a few years later his career was ruined by drug addiction.

The outstanding student of our class was Wilfred Trotter. We were to meet again years later over an operating table. I assisted him when he operated on my old friend Lord Beaverbrook for actinomycosis in 1918.

I was so engrossed in my studies that there was no time for outside diversions, although I did take a day off to attend the Derby, where I saw the Prince of Wales (later King Edward VII) win with his horse Persimmon. I also won £3.

In 1895 the trial of Oscar Wilde created sensational news and I was fortunate in being able to get into the Old Bailey on the day that Sir Edward Carson cross-examined Wilde. I shall never forget Wilde's brilliant defence.

Another memory is that of attending a luncheon given by the College to Dr. Starr Jamieson upon his return to England after his abortive raid into the Transvaal in 1896. He had been a medical student at University College.

In the autumn of 1896 I went up for my final examination. It was the first year of Sir William MacCormac's Presidency and he was one of the examiners. I still recall one of his questions. He was a tall man and, holding a truss high above his head, he asked me to tell him whether it was for an inguinal or a femoral hernia.

When the results of the examination were made known, we who were fortunate met and were congratulated by each of the examiners in turn. My parchment bears the names of H. G. Howse, Howard Marsh, Jeremiah McCarthy, Edmund Owen, N. Davies Colley, Henry Morris, William Anderson and John Langton. Edward Trimmer signs it as secretary.

The opportunities I had and the experience gained in attending the clinics in the University College Hospital and the other London Hospitals, and the teaching of eminent surgeons, were of tremendous value to me in my practice in Toronto. In the beginning I was so steeped in medical and surgical knowledge that when I first assumed my post as associate professor of Clinical Surgery in 1897, for a long time I needed no special preparation for my lectures.

I was the second Canadian to obtain the Fellowship of the Royal College of Surgeons of England. The diploma is my most treasured possession.

COLLEGE PUBLICATIONS

READERS ARE REMINDED that the following publications issued or sponsored by the College may be obtained from the Editorial Secretary, Royal College of Surgeons of England, Lincoln's Inn Fields, London, W.C.2.

A Catalogue of the Portraits and other Paintings, Drawings and Sculpture in the College. By William LeFanu, Librarian. 184 pages with 4 coloured and 52 black and white plates. £1 10s. 0d. (Postage 1s. 9d.).

The History of the College. By Sir Zachary Cope, F.R.C.S. 376 pages, fully illustrated. £3 3s. 0d. (plus 2s. postage).

Lives of the Fellows, 1930–1951. By the late Sir D'Arcy Power, K.B.E., F.R.C.S., Honorary Librarian, and continued by W. R. LeFanu, M.A., Librarian. A single volume, bound in blue cloth, of 889 pages, containing the Lives of all Fellows known to have died between 1930 and 1951. £2 2s. 0d. post free.

A Record of the Years from 1901 *to* 1950. Edited by Sir Ernest Finch, M.D., M.S., F.R.C.S. A slim volume, illustrated, containing a brief history of the College between the centenary and the 150th anniversary of the foundation with lives of all the Presidents since 1900, written by special contributors from their personal knowledge. In red cloth 9s. post free or red paper covers 5s. 6d. post free.

A Guide to the Hunterian Museum (Physiological Series). This gives a brief account of the physiological section of John Hunter's museum, the scope, design and historical value of which is unique. 48 pp. 1s.

A Descriptive and Historical Catalogue of the Darwin Memorial at Down House. Charles Darwin and his family lived at Down House, near Orpington, Kent, for forty-two years and it was here that most of his scientific investigations were made, including his work on the Origin of Species, published in 1859. 33 pp. 1s.

The Portraiture of William Harvey. The Thomas Vicary Lecture for 1948 by Sir Geoffrey Keynes, M.A., M.D., F.R.C.S. With a descriptive catalogue and 33 reproductions of the portraits. £1 5s. 0d.

**William Clift.* By Jessie Dobson, B.A., M.Sc., Anatomy Curator. A biography, fully illustrated, of the first Conservator of the Museum at the College. Published by William Heinemann Medical Books Ltd. Bound in blue cloth; 144 pages with frontispiece portrait and 31 plates. 8s. 6d. post free.

The present position of cardiac surgery. The Bradshaw Lecture for 1957 by Sir Russell Brock, M.S., F.R.C.S. Blue cloth binding, 6s. 0d. post free.

*A separate cheque for this publication would be appreciated.

THE DARWIN MEDAL

CHARLES DARWIN WAS born in Shrewsbury on 12th February 1809, and it was just 50 years later that the work for which he is most remembered—*The Origin of Species*—was published. The Academy of Sciences of the U.S.S.R. celebrated this double anniversary by holding a meeting in November 1959 in the great hall of the University of Moscow. The Oration was delivered by Academician Pavlovsky and this was followed by a short address by Dr. W. E. Swinton, then President of the Museums Association (of Great Britain). Groups of schoolchildren then paraded, some carrying a fine model of the " Beagle ", others holding pigeons to demonstrate some of the results of Darwin's researches, and recitations were made in French, English and Russian. To mark the event also, the Academy caused a medallion to be struck, some copies of which were

Fig. 1

presented after the above ceremony. The obverse shows a profile of Charles Darwin, his name and dates, and the reverse bears a representation of the " Beagle " together with the words " Origin of Species " (Fig. 1).

On 23rd May this year, the President and the Anatomy Curator were invited to visit the Soviet Embassy at 18 Kensington Palace Gardens. The guests were received by the Chargé d'Affaires of the U.S.S.R. in Great Britain, Mr. V. Loginov, and members of his staff. Mr. Loginov gave a short address of welcome, together with an account of the events that had given rise to this occasion. Medals were then presented by him to members of the Darwin family, Presidents of learned societies and institutions, and others. This ceremony was followed by the showing of

a very fine colour-film of Russian youth activities and progress in the arts, after which the visitors were invited to partake of refreshments, which included caviar, vodka and Caucasian wines, as well as the more usual cocktail delicacies. Tea from the samovar was also served.

АКАДЕМИЯ НАУК СССР

Г-ЖЕ ДЖЕССИ ДОБСОН

Глубокоуважаемая г-жа Добсон,

Оргкомитет по проведению юбилея Ч. Дарвина просит Вас принять в дар настольную медаль, выбитую по поручению Президиума Академии наук СССР в ознаменование 150-летия со дня рождения и 100-летия со дня опубликования «Происхождения видов» гениального английского естествоиспытателя Ч. Дарвина.

Председатель
Юбилейного оргкомитета
академик

(Е. Н. Павловский)

Fig. 2

Accompanying the medal was a certificate (Fig. 2), the translation of which reads as follows:

" The Organizing Committee for the Charles Darwin Anniversary asks you to accept this Medallion, which has been struck by the Presidium of the U.S.S.R. Academy of Sciences to commemorate the 150th Anniversary of the birth of Charles Darwin, the brilliant English natural scientist, and the centenary of the publication of his work *The Origin of Species*.

(*Signed*) E. N. PAVLOVSKY,
Academician,
Chairman of the Anniversary
Organizing Committee."

A PILGRIMAGE TO COS

by

W. R. LeFanu, M.A.

Librarian of the College

THE COUNCIL OF THE COLLEGE generously made it possible for me to attend the meeting of the 17th International Congress of the History of Medicine in Greece last September. It was a most interesting and stimulating experience. The main theme for discussion was the work and influence of Hippocrates, and the programme included "a pilgrimage to Cos" to visit the places where the father of medicine practised more than 2,000 years ago.

Professor S. Oeconomos, the president of the Greek committee of the Congress, and Professor B. Malamos, the honorary secretary, had arranged

The Plane-tree of Hippocrates.

a number of excursions to the famous sites and monuments of ancient Greece, so that the first half of the Congress was more archaeological than medico-historical. As a young man, before I came to the College thirty-one years ago, I worked in the library of the Society for Hellenic Studies, and it was a particular pleasure to me to see for the first time the beautiful places and fascinating remains of a vanished civilization, so long familiar at secondhand. We were lucky enough, too, to enjoy throughout the fortnight the most glorious sunshine.

After the formal opening at the University of Athens, the first regular meeting was held in the open-air theatre at Epidauros, rightly called " the most perfect auditorium in the world ". The natural curve of the hillside was so cunningly graded by the ancient architects that an ordinary speaking voice can be heard with ease from the floor to the topmost rank of seats. Epidauros was the site of the Asclepieion, the sacred sanatorium traditionally associated with the mythical Aesculapius, but the buildings, apart from the theatre, are ruined beyond recognition. We had reached Epidauros by way of Corinth with its Roman-imperial ruins, Mycenae with its famous prehistoric castle, and Nauplia, the Greek Naples with its memories of Venetian dominance and its incomparable view of sea and mountains. It was from here that most of the British and Anzac troops withdrew by night in 1941 under the overwhelming German air attack. After the meeting the 150 congressists went aboard a steamer and sailed overnight for Crete. Here we explored the famous Palace of Knossos, whose discovery sixty years ago by Sir Arthur Evans revolutionized knowledge and appreciation of ancient life and art. The Knossos " finds ", beautifully displayed in the Museum at Heraclion, explain this revolution better than the Palace itself. At Heraclion, too, the Congress was entertained by the President of the Medical Society.

Next day we visited Rhodes, where the Knights Hospitallers ruled for two hundred years between their expulsion from the Holy Land and their establishment in Malta. Their splendid buildings, including the spacious fourteenth-century Hospital, were carefully and not excessively restored by the Italians during their thirty years' occupation (1918–46). We were then taken on a long excursion through the wild countryside of the isle to see the breath-taking view of Lindos, and afterwards climbed up to this fortress of the Hospitallers, on a headland between two rock-guarded harbours.

On the third day we reached the goal of our pilgrimage, the Isle of Cos. Landing early under the Hospitallers' castle, we found the quay strewn with bay leaves to welcome us. A short walk, and we all assembled under or near the plane-tree where Hippocrates is supposed to have held his consultations. This is the oldest and probably the most wide-spreading tree in Europe, still fecund of leaf and fruit.

We then made our way out of the town to the hill-side where the Asclepieion, the hospital or sanatorium of Hippocrates, has been uncovered and partially restored. There are three broad terraces connected by wide flights of stone steps; these were the terraces of " incubation ", where the patients lay in the open. In this sacred spot a formal meeting of the Congress was held in the blazing sun, some papers were read, and representatives of the different nations signified their adherence to the ideals of Hippocrates and the purposes of the new International Hippocratic Foundation of Cos.

There followed a simple but striking ceremony: a small procession came down the great stairway from above us, girls and men in ancient Greek dress, the girls carrying baskets of herbs and the men playing on flutes. When they reached the group of Congress members their leader read out the Hippocratic Oath (in Greek) and the many doctors present voiced their assent. A generous entertainment of wine and fruit was then given us by the Mayor of Cos, with a printed copy of his Council's resolution of welcome and a leaf from the apparently immortal plane-tree.

We sailed next to the holy Isle of Patmos, where the Book of Revelation was written, and made the steep ascent to the fortress-monastery of St. John. The monks possess a famous library rich in gospel manuscripts and a treasury of early Byzantine paintings and marvellous church-plate.

Leaving these easterly islands we turned west again towards Athens, spending a morning on the way at Delos, the small but famous island which was the centre of the worship of Apollo the god of healing, and later the great slave-market of the Roman empire.

Congress lectures were given each evening on the boat, but the main meetings occupied three full days in Athens. As the only British representative I was invited to take the chair at one of the sessions, and made a short address on the British contributions to the study of Greek medicine, mentioning the work of Francis Adams, W. A. Greenhill, and E. T. Withington. Most of the papers were antiquarian, but there were some valuable contributions on medical ethics, the use of history in medical education, and similar topics. An interesting discussion on medical terminology, in which I joined, was started by a learned and broad-minded address on the value of comparative linguistic studies of medical terms.

The final day was spent in the long drive to Delphi, the seat of the famous oracle, and the most beautiful and sacred site in Greece. In his farewell speech in the ancient theatre there, the president of the Congress assured us that the oracle had once again given an auspicious answer!

There were many Americans at the Congress, some of them old friends who have often visited the College, many French, Belgian, and Dutch delegates, a friendly group of Russians, and others from many countries, with whom we made such contacts as language difficulties allowed. Our Greek hosts were friendly and welcoming in the highest degree. Even amid the haunting beauty of Greece, these personal contacts are the really valuable part of such a gathering.

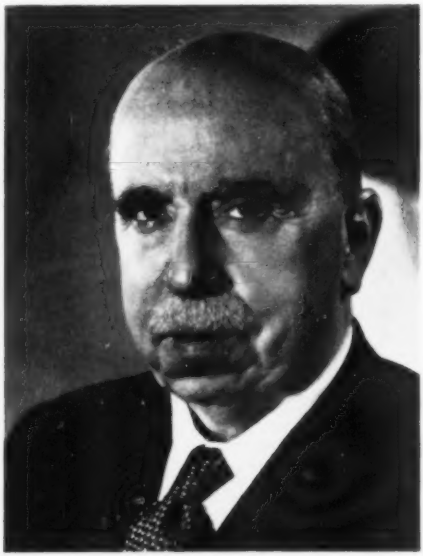
SIR HARRY PLATT, Bt.

DURING A RECENT visit to the United States, Sir Harry Platt gave the Edward Holman Skinner Memorial Lecture before the Kansas City Southwest Clinical Society on October 3rd, his subject being "Whither Medicine?"

In Memoriam

SIR HAROLD GILLIES, C.B.E., F.R.C.S., Hon. F.A.C.S.

It is curious that my first impression of Gillies, the man who even at that time, and it is 27 years ago, was acknowledged as the father of plastic surgery in England, was quite impersonal. He was allocated a few beds in a general surgical ward in which I worked and for some weeks his presence produced no reaction. One morning I saw a reconstruction of a destroyed cheek so surprising in its perfection that I determined then and there to try to cultivate the acquaintance of the man who was so obviously a master of his craft.



Sir Harold Gillies

Slowly thereafter the picture of the man emerged—superimposed as it were upon the background of surgical perfection. In the process of learning how this perfection had been achieved one learned also something of the man himself. It became obvious that the surgical skill so much admired was perhaps no more than many another might possess—but that it was lifted into the realm of international renown by the questing nature of the mind that possessed it.

To him no problem was identical with its predecessor—no patient possessed all the characteristics of another—no surgical procedure could be expected to produce perfection unless it were capable of modification to suit the individual needs. Nothing was standardized.

This characteristic of nonconformity was probably the most important weapon in his armoury. Ten years before, as a golfer playing to international standards, he had created alarm and despondency by using a beer bottle topped with a length of rubber tubing as a tee. In his hands the results were better than those he obtained by the regular approach and this alone was his justification.

Ten years later as Consultant in charge of Rooksdown Centre for Plastic Surgery he was immersed in the problems of the second war. The first war established his reputation—the second enhanced it. In both he was surrounded by young men drawn from all the quarters of the world whom he trained to fill positions in the forces and in civilian practice. His approach to teaching was unorthodox—his methods were sometimes brusque almost to the point of incivility.

He emerged from the first world war sharing only with Kilner the confidence that there existed a peace time demand for the reparative skills born of war experience. They had with them Kelsey Fry to help with the dental aspects of the problems of congenital lesions, and all of them were dependent on the entirely new approach to anaesthesia supplied by Magill.

In the decade 1920–1930 British Plastic Surgery was born.

Gillies completed his work in the second war with the formation of the British Association of Plastic Surgeons. Thus in 1946 his work for the Specialty, commenced almost single handed, reached its acme. It was but natural that the first President of the Association should have been Gillies himself.

He still remained restless and enquiring. He continued to train men from all parts of England, from the Dominions and from both continents. He travelled widely to the Scandinavian countries, to America, to Jugoslavia and last of all to India, where as recently as last year he spent some months in teaching, operating and advising.

His impressions here and abroad are perpetuated in his paintings—a skill first acquired during an enforced confinement to bed in the 1930's.

His experiences were in part recorded by his latest book of which he was co-author at 75. Even that bears but little relationship to the usual concept of a textbook—but it illustrated the skill, the eagerness of the mind and the brilliance of the improvisation of its senior author.

Now he has gone and it may be said that he was one of the few whose work was almost complete. He had by his own effort, by his imagination, his thought, his artistry and his skill, been responsible for the creation of Plastic Surgery as applied in wars and peace. The evolution of all surgery is now steadily advancing through the phase in which the art and the craft were paramount, to a stage in which the biochemists and the biophysicists are increasingly in demand. The spectacular techniques of yesterday are the accepted standards of to-day, but there will always be the need for appreciation of the individual as a person and as a problem.

No one contributed more to that knowledge than Gillies—to him his Specialty, and indeed the whole of Surgery, will always owe a debt of admiration and gratitude.

R. M.

ANATOMICAL MUSEUM

THE SPECIAL DISPLAY for the month of November consists of historically interesting specimens and donations including John Hunter's cuff-links, recently placed on loan by one of Sir Richard Owen's granddaughters.

APPOINTMENT OF FELLOWS AND MEMBERS TO CONSULTANT POSTS

A. W. BRUCE, F.R.C.S.	Associate Professor and Head of the Department of Urology, Queen's University, Kingston, Ontario, Canada.
I. M. HALLACK, F.F.A.R.C.S.	Consultant Anaesthetist to the Manchester Regional Hospital Board.
A. H. SWITHINBANK, F.R.C.S.	Consultant Surgeon to the Wigan and Leigh Group of hospitals.
G. W. DUCKWORTH, F.F.A.R.C.S.	Consultant Anaesthetist, Royal National Orthopaedic Hospital.
J. WOODLEY, F.F.A.R.C.S.	Director of Anaesthesia and Resuscitation, Preston and Northcote Community Hospital, Victoria, Australia.
J. W. McCLOY, F.F.A.R.C.S.	Consultant Anaesthetist, Royal Salop Infirmary.

We regret an error in a previous issue. Mr. A. M. WILEY, M.B.E., F.R.C.S., has been appointed as Attending Surgeon, Toronto Western Hospital, and Clinical Instructor in Surgery, University of Toronto, and not to the University of Texas as previously printed. We apologize to Mr. Wiley for any inconvenience this error may have caused him.

The Editor is always glad to receive details of new appointments obtained by Fellows or Members, either through the Hospital Boards or direct.

PROCEEDINGS OF THE COUNCIL IN OCTOBER

AT A MEETING of the Council on 13th October 1960, with Sir Arthur Porritt, President, in the Chair, Professor Erling Dahl-Iversen of Copenhagen and Professor Jan F. Nuboer of Utrecht were elected Honorary Fellows of the College.

A resolution of condolence was passed on the death of Sir Gordon Gordon-Taylor, a former member of Council and Vice-President of the College, and the Council stood for a moment in tribute to his memory.

Professor L. N. Pyrah, Professor of Urological Surgery at the University of Leeds, who headed the poll at the Election to Council held in August, was admitted to the Council.

Mr. Charles Keogh (The London) was admitted to the Court of Examiners. Dr. G. Jackson Rees (Liverpool) and Dr. I. Parry Brown (The London) were admitted to the Board of Examiners for the Fellowship in the Faculty of Anaesthetists.

Professor B. Cohen was admitted as Nuffield Research Professor of Dental Science.

The Handcock Prize was awarded to Dr. Sonia G. Bolton of King's College Hospital. A. S. Coulson of Hendon Grammar School and Queens' College, Cambridge, was admitted as the twenty-ninth Macloghlin Scholar.

One diploma of Fellowship and two diplomas of Membership were granted.

Diplomas of Fellowship in Dental Surgery were granted to 14 candidates, and two Licences in Dental Surgery were granted. 13 Diplomas in Orthodontics were granted.

Diplomas of Fellowship in the Faculty of Anaesthetists were granted to 47 candidates.

The following diplomas were granted, jointly with the Royal College of Physicians: *Laryngology and Otology* (1), *Child Health* (99), *Opthalmology* (42), *Physical Medicine* (7), *Tropical Medicine and Hygiene* (63), *Industrial Health* (2), *Medical Radio-Diagnosis* (1), *Psychological Medicine* (2) and *Anaesthetics* (1).

The following hospitals were recognized under paragraph 23 of the Fellowship regulations:

Hospitals	Posts Recognized		
	General (6 months unless otherwise stated)	Casualty (all 6 months)	Unspecified (all 6 months)
Londonderry — Altnagelvin Hospital	2 Surg. Regr.		
West Bromwich and District General Hospital (additional)	S.H.O.		
Solihull Hospital	H.S.		
Bedford — General Hospital (decennial revision)	Surg. Regr. 3 H.Ss.	Sen. Cas. Offr.	Regr. (Orth.) H.S. (Orth.)
Leicester — Royal Infirmary (and Hinckley and District Hospital and the Fielding Johnson Hospital) (additional)	Surg. Regr. (12 months)		
Belfast — Ulster Hospital for Women and Children	S.H.O. Surg. Regr. H.O.		
London — Whipps Cross Hospital (additional and decennial revision)	3 Surg. Regrs. 3 H.Ss.	*for one additional year only.* Cas. Offr	2 Regr. (Orth.) 2 H.Ss. (Orth.) J.H.M.O. (Gyn. & G.-U.)
Chelmsford — St. John's Hospital (additional)	2nd pre-registration H.S. *Redesignation* S.H.O. (R.S.O.) to become Regr. (R.S.O.) and to be recognized for 12 months instead of 6 months		
Limerick—Regional Hospital	2 Surg. Regr.		
Shrewsbury — Royal Salop Infirmary, Copthorne and Monkmoor Hospitals (additional)	Surg. Regr. to the group		
Galashiels — Peel Hospital	Regr. S.H.O.		Regr. (Orth.) S.H.O. (Orth.)
Chichester—Royal West Sussex Hospital (additional)		S.H.O. Cas. Offr.	
Ashford (Kent) — Willesborough Hospital	*For two years only* H.S.		
Nottingham — City Hospital (additional)			Regr. (Plastic Surgery)
London—St. Mary Abbot's Hospital (additional)	2nd Surg. Regr. (6 months) (to rotate with 1st Surg. Regr., also 6 months)	Cas. Regr.	
Lincoln — County Hospital (additional)	S.H.O.		
High Wycombe and District War Memorial Hospital (additional)			*Under para.* 23 (c) Regr. E.N.T.
London — Royal London Homoeopathic Hospital (additional)	Surg. Regr.		
Aylesbury — Tyndal General Hospital (instead of Group appointment) (additional)			*Under para.* 23 (c) Regr. E.N.T.
London — Highlands Hospital (additional)			H.S. (Orth.)

Hospitals	Posts Recognized		
	General (6 months unless otherwise stated)	Casualty (all 6 months)	Unspecified (all 6 months)
London — Fulham Hospital (additional)	H.S. to Surgical Professorial Unit		
Ryde — Royal I.O.W. County Hospital (additional)		J.H.M.O.	
Reading — The Royal Berkshire Hospital (redesignation)			*Under para.* 23 (*c*) Redesignation of H.S. as Senior House Surgeon
Isleworth — West Middlesex Hospital (additional)		Cas. Regr.	
Warrington — Infirmary (additional)			Reg. (Orth.) S.H.O. (Orth.)

Ophthalmological Posts
Extension of Recognition from 6 to 12 months

Hospitals	*Under para.* 23 (*b*) (for 12 months)
Durban — Addington Hospital	Registrar
Bradford — Royal Eye and Ear Hospital	Registrar House Surgeon

SAYINGS OF THE GREAT

"*It is in medicine as in finance—much poverty and much paper may co-exist. It is not the settled problems of medicine about which much is written, it is rather concerning those matters of which many things still need to be made clear.*"

Lord Moynihan.

"*I regard with a little suspicion the occurrence of large numbers of cases in the practice of any man within a brief period, and I feel that operations may perhaps be performed in conditions which do not in truth demand them.*"

Lord Moynihan.

"*It is easy to play the game from the grandstand.*"

Harvey Cushing.

(*Submitted by Professor Lambert Rogers, C.B.E., V.R.D., F.R.C.S.*)

Contributions are invited.

DONATIONS

THE FOLLOWING GENEROUS donations have been received during the last few weeks:

Appeal Fund—Donations:

$10,000	Earl C. Sams Foundation, Inc., Texas
£262 10s. 0d.	Cow & Gate Ltd. (further gift)
£200	Executors of the late Miss M. B. Johnson
£115 10s. 0d.	Dodwell & Co., Ltd.,
£105	Allied Services, Ltd. (further gift) Babcock & Wilcox, Ltd. (further gift) British Glues & Chemicals, Ltd. (further gift) Consolidated Tin Smelters, Ltd. (further gift) Gordon L. Jacobs & Co. Lambert Bros., Ltd. (further gift) Pember & Boyle Slough Estates, Ltd. (further gift)
£100	Esso Petroleum Co., Ltd. (further gift) Ilford Ltd. (further gift) Keith, Bayley & Rigg Littlewood Charitable Trust (further gift) Rubery Owen Group Charitable Trust (further gift) The Worshipful Company of Drapers
£85 14s. 4d.	Kitcat & Aitken
£52 10s. 0d.	Capel-Cure Linton Clarke & Co. Toledo Woodhead Springs, Ltd. (further gift) United Glass, Ltd. (further gift)
£50	Courage, Barclay & Simonds, Ltd. (further gift) John Smith Lomax Fund (further gift) James H. Pullen (1942) Ltd. Westinghouse Brake & Signal Co. (further gift)
£26 5s. 0d.	Blundell, Spence & Co., Ltd. (further gift) Bradford Dyers' Association (further gift) J. H. Caramel (further gift) Schweppes Charitable Trust (further gift)
£25	W. H. Allen, Sons Co., Ltd. L. G. Chater, Esq. Delta Metal Co., Ltd. (further gift) Moon Bros., Ltd. Messrs. J. & A. Scrimgeour Venesta, Ltd. (further gift) Williams Deacon's Bank, Ltd. (further gift) Mrs. F. Wilson
£21	Wm. Mallinson & Sons, Ltd. (further gift) Wolverhampton Metal Co. (further gift)
£20	Miss C. Edmondson (further gift) Mrs. M. M. MacDonald (further gift) F. M. Wells, Esq.
£16 16s. 6d.	Messrs. Laing & Cruickshank
£10 10s. 0d.	Albion Sugar Co., Ltd. Mrs. J. Alesbury Grand Order of Water Rats F. H. Lloyd Charitable Trust (further gift) Thomas Merry Charitable Trust (further gift) Roger Mortimer, Woodall, Yardley & Co. Gillett Bros. Discount Co., Ltd. (further gift)

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£7 7s. 0d.	Messrs. G. W. Dawes & Co.
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£1	H. C. Beaumont, Esq. (further gift) H. Uppadine & Son
10s. 0d.	F. W. Pounds, Esq.

Appeal Fund—Covenants:

£100 p.a. for 7 years + tax	Wilmot Breeden, Ltd. (further gift)
£25 p.a. for 7 years	Manufacturers' Life Insurance Co.
£25 p.a. for 7 years + tax	L. G. Chater, Esq.
£10 p.a. for 6 years	A. Whitcombe, Esq.
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The McIndoe Memorial Fund:

£262 10s. 0d.	Rainsford Mowlem, F.R.C.S.
£105	Thomas Cliffe Fitton Will Trust
$100	Dr. Donald C. Balfour, Hon. F.R.C.S.
£5 5s. 0d.	Miss K. M. Damon J. B. David, F.R.C.S.
£5	R.A.F. Association (Westminster)
£2 2s. 0d.	R.A.F. Association (Putney)

Endowment of the Chair of Biochemistry:

£10,000	Jack Cotton Charitable Trust (2nd instalment)

Voluntary subscriptions and donations by Fellows:

The following Fellows of the College, Fellows of the Faculty of Dental Surgery and Fellows in the Faculty of Anaesthetists have generously given a donation or have undertaken to make a voluntary annual subscription under covenant.

H. G. E. Arthure, F.R.C.S.
Surg. Capt. J. L. S. Coulter, F.R.C.S., and Mrs. Coulter
A. H. Hunt, F.R.C.S.
F. C. Hunt, F.R.C.S.
E. T. McCartney, F.R.C.S.
P. H. Newman, F.R.C.S.
E. J. Perks, F.D.S.R.C.S.
C. H. J. Rey, F.R.C.S.
A. Ritchie, F.F.A.R.C.S.
P. R. Wheatley, F.R.C.S.
Miss F. B. Whitney, F.F.A.R.C.S.

DIARY FOR NOVEMBER

Fri.	18	5.00	Board of Faculty of Dental Surgery.
Wed.	23		First L.D.S. Examination begins.
Thur.	24		D.P.M. Examination (Part I) begins.
		5.00	Professor J. F. NUNN—Hunterian Lecture—The distribution of inspired gas during thoracic surgery.
Tues.	29	5.00	Professor H. B. STALLARD—Hunterian Lecture—Malignant melanoma of the choroid treated with radio-active applicators.
Wed.	30		Primary F.F.A. Examination, Second L.D.S. Examination and D.P.M. Examination (Part II) begin.

DIARY FOR DECEMBER

Thur.	1		Pre-Medical Examination and D.L.O. Examination (Part I) begin.
		5.00	Dr. M. S. ISRAEL—Erasmus Wilson Demonstration—Some chronic inflammatory lesions of the small intestine.
		5.30	Mr. J. PENNYBACKER—Otolaryngology Lecture—Acoustic neuroma.
Fri.	2		Date of election of Fellows to the Board of Anaesthetists announced.
Mon.	5		Basic Sciences Lectures and Demonstrations for Dental Students begin.
Wed.	7		ANNUAL MEETING OF FELLOWS AND MEMBERS. D.P.H. Examination begins.
		2.30	Sir STANFORD CADE—Bradshaw Lecture—Malignant melanoma.
		3.30	Annual Meeting of Fellows and Members.
Thur.	8		First Membership Examination and D.L.O. Examination (Part II) begin.
		2.00	Ordinary Council.
		5.00	Mr. H. J. SEDDON—Robert Jones Lecture—Manchester Ship Canal and the Colonial Frontier.
Wed.	14	5.00	Professor OWEN DANIEL—Hunterian Lecture—The complications of diversion of the urinary stream.
Thur.	15	5.00	MR. L. TURNER—Arris and Gale Lecture—The structure of arachnoid granulations, with observations on their physiological and pathological significance.
Fri.	16		Basic Sciences Lectures and Demonstrations and Dental Lectures and Clinical Conferences end.
Wed.	21	5.00	Board of Faculty of Anaesthetists.
Fri.	23		Last day for nomination of candidates for election to the Board of Faculty.
Sat.	24		College closed.
Mon.	26		College closed.
Tues.	27		College closed.
Wed.	28		College closed.

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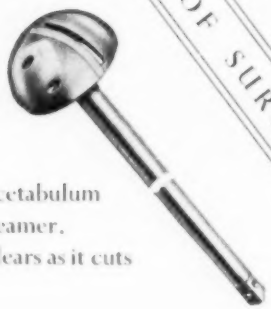

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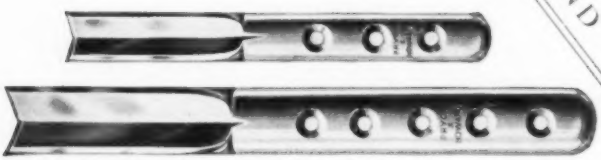

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WITH A WILL!

When you are consulted about bequests for Medical work which deserves support, please remember the part played by the Imperial Cancer Research Fund. It receives no official grant and is entirely supported by voluntary donation and bequest. Pioneer in the field of cancer research, this organisation was founded by the Royal Colleges of Physicians and Surgeons to undertake this vital work in its own laboratories. Please help us when you can!

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C.R.F. 94, Imperial Cancer Research Fund, 49 Lincoln's Inn Fields, London, W.C.2

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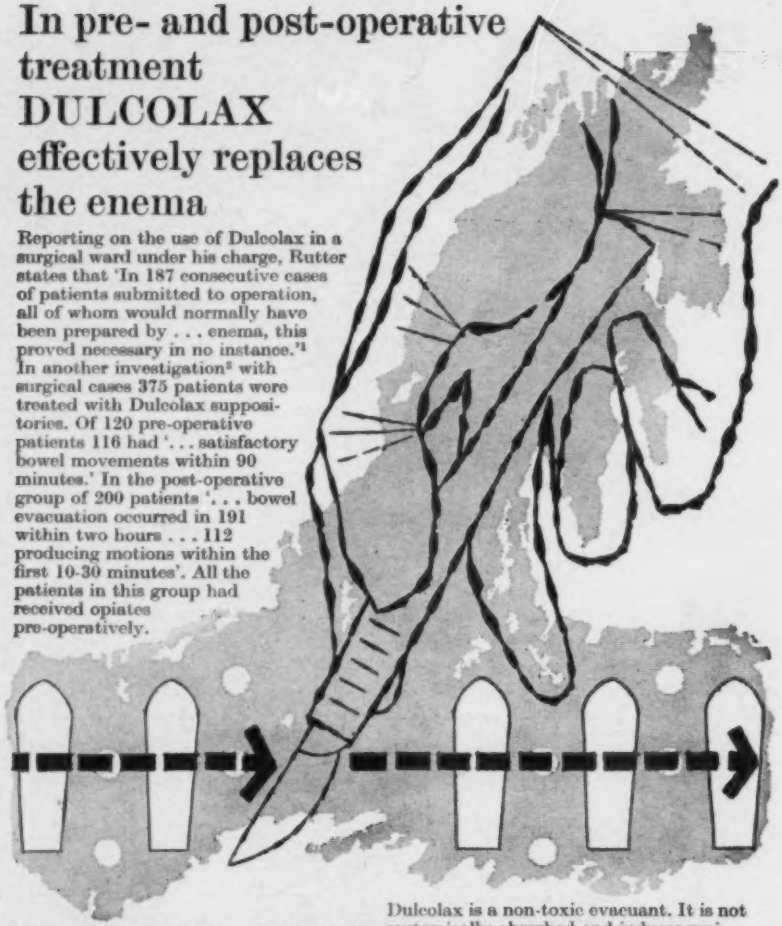

The significant results shown in these and many other trials conducted in many parts of the world indicate that Dulcolax is capable of replacing the troublesome enema for any specific medical, surgical or X-ray diagnostic purpose.

[1]Rutter, A. G., *Lancet*, 1959. i, 1173.
[2]Ganz, P., and Zindler, N., *Medizinische*, 1955, 29-30, 1042.

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EXAMINING BOARD IN ENGLAND

BY THE

ROYAL COLLEGE OF PHYSICIANS OF LONDON

AND THE

ROYAL COLLEGE OF SURGEONS OF ENGLAND

On behalf of the Board Mr. Harold Edwards, C.B.E., F.R.C.S. visited the Sudan during February and March 1960, as Visitor to the Faculty of Medicine and for the final examinations for the M.B.B.S. (Khartoum).

His report, having been approved by both the Royal Colleges, is appended.

Background

The Sudan covers an area of nearly a million square miles—about nineteen times the size of England. Some ninety per cent of its ten and a quarter millions live in rural areas on the banks of the Nile Rivers, in the deserts of the North and West, amidst the swamps of the central region, or in the bush of the tropical south. Apart from the "Three Towns"—Khartoum, Khartoum North, and Omdurman—there are only

seven towns of more than 20,000 inhabitants. Communications between them are for the most part extremely poor. Roads, except in the south, are primitive or non-existent, and the railroad due south from Khartoum ends at Kosti, more than five hundred miles north of Juba, the chief town of Equatoria. The journey by boat from Khartoum takes about twelve days, but there is an air service by Dakota three times weekly.

The population is composed of about six hundred tribes gathered into 56 tribal groups speaking between them 115 different languages. Some of the tribal settlements bestride ill-defined national boundaries. Many of the tribes, comprising a million souls, are nomadic. Each year some thirty thousand pilgrims cross the western frontier on their way to Mecca, and there are in addition many independent groups journeying across the land for the same purpose who may take five years to reach their destination, stopping on the way to cultivate crops and to gather harvests, or to work in the Ghezira cotton fields. The population is for the most part illiterate—it was recently estimated that 88% of the adults had never been to school*.

The list of endemic and epidemic diseases, varying in prevalence in different provinces and districts, includes malaria and kala-azar; hookworm, trypanosomiasis and bilharzia; leprosy, tuberculosis and yaws; cerebro-spinal meningitis and yellow fever; trachoma (said to be approaching an incidence of 100% in Northern Province); onchocerciasis and hydatid disease.

There is as yet no waterborn sanitation, and the infant mortality rate is thought to be one of the highest in the world.

It is against this background that the Sudan Medical Service and the method of preparation for entry into the Medical Service have to be viewed. The pessimistic tendencies that such a picture provoked at first were dispelled for the Visitor by the charm of the people, by the sterling qualities of the dedicated men he encountered throughout the Medical Service, and by the conviction that the many difficulties will in time be overcome.

One primary objective of government is to gather the country inhabitants into more formal communities so that education, public hygiene, and preventive medicine may be satisfactorily undertaken. This will clearly take time, for tribal customs and traditions rarely fit in with the ideas of Western civilization.

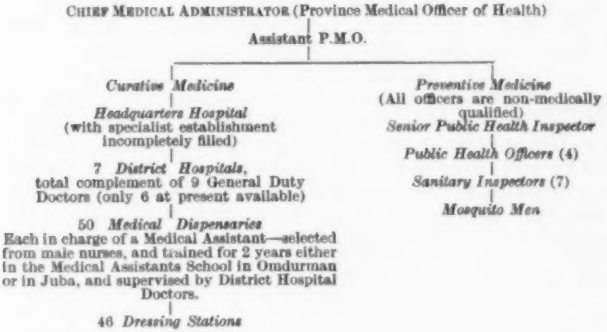
In the meantime the Medical Service does its best with its available resources to solve the problems confronting it. The

* Report of the Sixth Annual Conference, Philosophical Society of Sudan, 1958.

force of qualified doctors is very small—there are less than 200 of them all told in the Service, and there are extremely few specialists. There is not at present a single fully trained anaesthetist in the whole Sudan, and only one radiologist; there is not a single trained surgeon in Equatoria—a Southern province which is half again as big as England. Other provinces are similarly placed. In 1957 the total female nursing staff numbered about 108, of whom over half were European expatriates. Steps are being taken to remedy these basic deficiencies, so that in the not too distant future the establishments will it is hoped be filled.

Structure of the Medical Services in the Provinces

There are nine provinces comprising 11 medical administrative areas. Figures here quoted relate to the province of Equatoria.



The District Hospital Medical Officer, with whom in this context one is chiefly concerned, may be a recent graduate working in complete medical isolation except for the occasional visit of the physician from headquarters, and being perhaps a hundred miles or so away from his nearest medical colleague. His duties include the administration of his hospital; medical and surgical treatment of his patients, including anaesthesia; arranging for the management of groups during endemic or epidemic outbreaks; and supervision as far as he is able of Medical Dispensaries in his district. No X-rays may be available to him, and his equipment is in general minimal. His male nurses are conscientious and industrious, but imperfectly trained for the most part.

Some idea of the responsibilities such a young graduate may have to face may be gained from two typical District Hospitals visited. They are similarly placed. At Yei for

example the medical officer had under his charge 83 beds, one third of which were occupied by injured men women and children—fractures, spear wounds, animal wounds sustained during hunting. During the past 11 months he had performed 3 Caesarian sections, a Caesarian hysterectomy, and four operations for acute intestinal obstruction, all under spinal anaesthesia administered by himself. In addition he had the care of 61 cases of sleeping sickness, housed in two specially constructed native type huts in which the only furniture was roughly made angareebs.

It is for service under conditions such as these that medical education in the Sudan needs to be geared at the present time. Those in charge of departments in the Medical Faculty of the University and who are responsible for the pattern of training and of medical education, make it their business to keep continuously abreast of the practical problems which confront the medical service by making treks into desert or bush, usually accompanied by senior students; they may unselfishly forfeit their annual leave, or a goodly part of it, in order to keep themselves in touch with prevailing conditions.

It was clearly desirable that the Visitor should similarly acquaint himself with practical working conditions as far as time allowed in order that he might be better fitted to understand the method and purpose of medical education, and the nature and scope of the examinations. All previous Visitors adopted this course, and the present Visitor followed their example. Thanks to the courtesy and generosity of the Ministry of Health he was able to spend a week in Southern Sudan before the examinations commenced. Dr. Abbas Hamed Nasr, the P.M.O.H. there, very kindly arranged for a tour of his province of Equatoria.

The Faculty of Medicine

University of Khartoum.

(*Dean:* Professor Dean A. Smith, O.B.E., M.A., M.D., B.Chir.(Cambs.), D.T.M. & H.)

The chief event of 1960 will be the opening of the new building, now approching completion in the grounds of the University Medical School (originally known as the Kitchener School of Medicine). This three-storied building is intended to house the Departments of Anatomy and Physiology, at present accommodated in the University buildings on the site of the original Gordon College two miles distant. The advantage accruing to all concerned in having these two vital departments on the spot is self-evident. Biochemistry, hitherto a responsibility of the Department of Physiology,

became as from July 1959 an autonomous Department under the direction of a Reader, a development which the new building has made possible. The Department of Pathology will also be housed there. It is anticipated that its present quarters will be occupied by the Department of Hygiene and Public Health, a move which seemed to the Visitor to be more than justified in view of the extreme importance of the department in relation both to medical education and to the health of the country. Up to the present the Department has made do with what is little more than a two-roomed hut. While it is true that most of the work of the Department is in the field, yet its importance entitles it to a status and dignity which is very difficult to achieve and sustain without a headquarters commensurate with its function.

It may be mentioned here that after, it is understood, prolonged negotiations, Hygiene and Public Health was raised in March of this year to specialist status. This appears to have given general satisfaction. The advancement should encourage recruitment, hitherto inadequate, to a side of medicine which from a National viewpoint rivals in importance that of curative medicine.

The additional accommodation provided by the new building will enable the school to increase its intake of students by five annually, from the present 35± to the ultimate goal of 50, which should be reached by 1965.

It must be borne in mind by those who may wonder why an increase up to 50 should not be made forthwith that there are considerations other than accommodation. Medical education is almost entirely financed by the State, which educates, feeds and houses the students; and the Sudan is not yet so prosperous that its economy can withstand the impact of sudden high jumps in expenditure. The build-up must be gradual. Furthermore, basic educational facilities are not yet sufficiently developed to yield more students of the necessary mental calibre to fill all the University Faculties, particularly the medical faculty, which is generally held by those most knowledgeable to skim the cream. All these advances take time, but it is pleasing to note that the rate of progress is accelerating, as far as the observer can discern.

A question which is widely discussed and which at times becomes controversial is whether the pre-registration period after qualifying should revert from one year to two years, as it was originally. On the academic side all to whom the Visitor spoke, including resident medical officers and senior students, were very strongly in favour of two years. At present the one pre-registration year is spent thus:—3 months medicine; 3 months surgery; 3 months obstetrics and gynaecology; 3 months children, or 'eyes', or other branch

according to choice. All seem to think that having regard to the responsibility to the public that the young doctor has to bear, the period of one year is inadequate.

The Medical Directorate appears to be in sympathy with this, but takes the view that it cannot afford the two year period because of the shortage of doctors, although it has been pointed out that this shortage would only affect one year's supply.

It would be an impertinence for the Visitor to offer his unsolicited opinion on this matter, as his terms of reference as strictly interpreted stop short at the final examination level. However, when discussing the matter in the presence of the Minister he gave it as his opinion that the short term policy was in danger of lowering medical efficiency, and that patient welfare must suffer in quality having regard to what was expected of the general duty officer when posted to remote areas. No doctor really anxious for the good of his patients can welcome undertaking responsibilities such as have already been outlined after so short a period in 'statu pupillari'. Even in England there are very many who feel that 12 months pre-registration is insufficient to fit a man for complete clinical care of patients. If this is true for England how very much more true must it be for the Sudan, where many fundamental health problems are still unsolved.

One of the excellent features of the clinical years is the organisation by the Department of Hygiene and Public Health of conducted district tours for the students. Other heads of departments, including the pre-clinical, also take students on similar expeditions from time to time. Although both 3rd and 4th year students are catered for, the main tours are arranged for the 5th and final years, and take place during the vacations. In the last December vacation short visits were made to Wadi Halfa, to Merawe, to Dongola, amongst other areas; and in the Summer vacation a 50 day tour was made to the Southern Provinces, and included short stays in the Belgian Congo and French Equatorial Africa. These tours must be of immense value. Having witnessed some of the problems associated with the organisation and having gained some idea of the difficultites of travel, the Visitor would like to place on record his admiration of the work of Dr. Anis, the Senior Lecturer and acting head of the Department, who is responsible for the arrangements in collaboration with the Dean, and who conducts many of the tours in person. This year he has the invaluable assistance of Dr. B. B. Waddy of the London School of Hygiene and Tropical Medicine.

There have been certain changes in the routine of each department which will be mentioned seriatim, but the chief

change in the over-all plan is that as from March 1961 the 2nd M.B. will be tripartite, consisting of Anatomy, Physiology and Biochemistry.

The work of all the departments is carried on with a lively enthusiasm and with a sense of mission which the Visitor, conscious of the many handicaps, found deeply impressive. One of the disabilities suffered by the Clinical departments is the paucity of secretarial assistance, which is almost non-existent, or at least a very haphazard affair. It would be a boon if this could be rectified, even if it meant only a part-time service from a properly constituted secretarial pool. Provision of this kind would free them to devote even more time to their clinical and educational tasks.

Finally the Visitor would endorse the view expressed by his predecessor to the effect that the burden of teaching placed upon the principals could be lightened by delegating some of the routine teaching to junior staff if and when such were available.

Post-Graduate Education

Undoubtedly the event of the year in this context was the holding last January of a Primary Fellowship Examination of the Royal College of Surgeons of England. This was an unqualified success. The examination was conducted on traditional lines by examiners on their return to England from the Primary Examination in Ceylon. Eleven candidates presented themselves. Four were successful. Eight of the candidates were Khartoum graduates of whom three were successful. The figures are too small for percentages to be quoted, but that the pass list was so high will cause no surprise to those who have been privileged to become acquainted with the Departments of Anatomy and Physiology. These departments are in the opinion of the Visitor fine training grounds for the embryo surgeon. They are very live departments, intent not only upon day-to-day teaching but also on research projects. Young surgeons-to-be, selected with care, who spend three months or so in their departments assisting with the teaching, and the experiments and investigations, would be acquiring just that kind of knowledge and experience which the Council regards as suitable preparation for a surgical career.

The 'experiment', inspired by Professor Julian Taylor, can be said to have been completely successful, and will encourage the Council of the Royal College of Surgeons to view with favour the possibility of making the primary examination in Khartoum a regular feature.

The Departments

Anatomy

Professor H. Butler, M.A., M.D., B.Chir.(Camb.)

A major experiment in the teaching of topographical anatomy is in progress. It is designed to obviate the grave disadvantages of the traditional method of early dismemberment of the body, in which, for example, the lumbo-sacral plexus is never observed as a whole, nor the great vessels visualised as continuous structures from the heart to their final destinations. The experiment embodies allocation of a group of students to one cadaver, which they will dissect completely in 4 terms. The cadaver is not dismembered until the final term, when the joints are dissected. The dissection time is thereby reduced from 5 to 4 terms and this releases the first term for extra classes in physical chemistry and biology. The dogfish is dissected during this period in order to acquaint the student with the fundamentals of vertebrate anatomy, and the term is concluded by a course in human osteology. Thus when the 2nd term begins the student should be well able to obtain maximum benefit from dissection of the human body.

This modified course is linked with the proposed change to a tripartite 2nd M.B. examination. The change does not imply that any less importance is attached to anatomy in medical education than hitherto, but recognises that it is necessary, with the increasing importance of biochemistry, to adjust the balance within the curriculum. Only in this way can the evils of overloading or expanding the pre-clinical course be avoided. Whereas in more highly developed countries there may be a case for shortening the time spent by the student in the study of anatomy, in the Sudan, where every general duty officer has at present also to be a ' surgical specialist ', the opinion of the Professor, shared by the Visitor, is that it is still important for the student to dissect the whole body.

Histology is the responsibility of the Anatomy Department, and when the new building becomes available it is intended to include in the curriculum staining exercises and to introduce a short course in practical embryology.

Research work has reached a high level during the current year, with concentration on the anatomy and embryology of the Galago, or Bush Baby, a most attractive bushy-tailed animal, a number of which are kept by the Professor in his department. Papers on a variety of subjects—embryology, physical anthropology and neuro-anatomy—have been prepared for publication this year.

Department of Physiology

Professor Dean A. Smith, O.B.E., M.A., M.D., B.Chir.(Camb.), D.T.M. & H.Eng.

The excellence of this department has been mentioned in previous reports, and the present Visitor wishes to place on record that he is in full agreement with the opinion of his predecessors. As in other departments the attention to detail in training and the conscientiousness of the staff compel admiration.

The chief change during 1959/60 year has been the splitting of biochemistry from physiology, a reorganisation in tune with the change from a bipartite to a tripartite 2nd M.B. Though it will remain under the same roof it becomes an autonomous department under the care of Dr. K. R. Adam, B.Sc., Ph.D.(Edin.), who has been appointed Reader in the University. Dr. Adam has hitherto been Senior Lecturer in the Department of Physiology for many years—he is in fact one of the oldest expatriates in terms of service, though not of age. This is a very welcome departure, for not only does it lessen the load upon the Department of Physiology, which, though a pre-clinical department, undertakes a great deal of clinical work, but it helps to bring into proper perspective the importance of biochemistry to modern medicine and medical education. The new Department will have an excellent start in that it will move with its erstwhile parent into the new building.

An additional establishment for a Sudanese graduate to work in the Department of Physiology has been created, bringing the total to three, one of whom is at present studying for the Ph.D. degree at St. Andrews University.

In collaboration with the Department of Anatomy the first term of the preclincal course has been devoted this year, as already mentioned, to a gap-bridging course in organic and physical chemistry, vertebrate zoology, protozoology, and entomology. This seems to have been a successful innovation.

Post-graduate and study facilities were accorded to aspirants to the primary fellowship, and a feature is made of linking pure physiology with clinical responsibilities. Active research continues, and three papers will be published this year from the department. Amongst the outstanding ventures is the investigation by Dr. Adam and Dr. Weiss, a Senior Lecturer from Hamburg, into the action of scorpion venom on skeletal muscle, a work which is exciting wide interest.

Department of Pathology

Professor J. B. Lynch, M.D., Ch.B.(Liverpool), F.R.C.S.

The department is facing difficulties which are hindering its development. Everyone would agree that the *raison*

d'être for a Professorial Department of Pathology in a Teaching Hospital is to provide a fully comprehensive educative and training programme in a subject which is basic to medicine. Though it will be conceded that there must be, and should be, overlap between all departments, pre-clinical and clinical, in preparing the undergraduate to become a doctor, it is fundamental to the purpose of the Department of Pathology that it should be the receiving station and sorting ground of the pathological material from all the clinical departments of the hospital of which it is an integral part.

This does not as yet wholly obtain in the Department of Pathology of the Faculty, and the reason appears to be a matter of history and not the fault of any individual. The historical details in brief appear to be as follows.

On the opposite side of the road and identical in architecture with the 'Kitchener' School of Medicine are the famous Stack Medical Research Laboratories. The present Director is Dr. Mansour Ali Haseeb. These laboratories are descendants of the Wellcome Laboratories, established in 1903 which sought, ***inter alia***, to promote the study of tropical disorders. Originally autonomous, the laboratories were taken over by the Department of Education of the Sudan Government in 1925 owing to the need for expansion and reorganisation of the Ghezira Cotton Scheme; and the opening in 1924 of the Kitchener School of Medicine. The laboratories were split up into various sections, some of which were attached to the Department of Agriculture. In 1926 the Sir Lee Stack Indemnity Fund Committee gave a sum of twenty-four thousand Egyptian pounds to cover the cost of building and equipping new laboratories, and thus the present Stack Institute came into being. One of the many duties assigned to it was the teaching of pathology, bacteriology and parasitology to the medical students of the newly-formed Kitchener School of Medicine, and this duty it continued to fulfil entirely on its own until 1952, when a Chair of Pathology in the Kitchener School was established. The first incumbent of the new chair was Dr. Robert Kirk, the director of the Stack laboratories. The Chair became vacant when Dr. Kirk retired in 1955, and remained so until December 1957, when the present holder was appointed.

The responsibility for the medical education of students is now solely that of the Professor, who is not linked with the Stack laboratories. A further break between the two institutions occurred in 1959, when the present Director of the Stack Laboratories resigned from the teaching staff of the Professorial department owing to the increasing demands upon his time of his duties as Director. This divorce at the top level did not however materially affect the position as regards the

investigation of, and reporting upon, pathological material emanating from the Ministry side of the Civil Hospital, the bulk of which is still submitted to the Stack Laboratories, thus depriving the Department of Pathology of useful material for the education of its students, and badly needed for the building up of its museum resources. A further handicap in the attainment of this end is the institution, as a result of a grant from the World Health Organisation, of a National Biopsy Service within the Stack Laboratories, to feed which all state Hospitals, including the Khartoum Civil Hospital, submit their specimens and biopsies to the Stack.

During these formative years, and perhaps owing to the geographical gap between the hospital and the Stack Institute, the Departments of Obstetrics and Gynaecology and of Medicine created their own individual departmental pathological services, and it is but natural that the heads of these departments are loth to see these services taken over by the Department of Pathology.

It will readily be apparent that such fragmentation creates a situation to the general detriment of the various interests which all seek to serve. The University, because one of its Faculty Departments is finding difficulty in developing and measuring up to the standard envisaged; the Department itself because it is not wholly achieving the purpose for which it was designed; the student because there is a deficiency in his basic education; the Stack Laboratories, because it is spending so much of its energies upon routine, with resultant loss of research potential; the Treasury, because of the cost of duplicated effort.

This situation clearly calls for reform. It is to be hoped that the forthcoming move of the Department of Pathology into the new building will provide the propitious moment for a conference in which all concerned can face realistically the need for a new approach.

It should not be thought from the foregoing that the department has not been active during the past year, despite the fact that the only staff available for teaching and routine have been the Professor himself, two expatriate technicians, and a Sudanese trainee technician. There is an establishment for a Senior Lecturer (now vacant) and a Lecturer, but the present holder of the latter post is pursuing a two year study course in England. The burden of teaching has been increased by the resignation of Dr. Mansour Ali Haseeb, to which reference has already been made.

The main routine work has been in morbid anatomy, and though the number of post mortems remains very small, due to circumstances quite outside professorial control, the number of biopsy examinations has shown a considerable increase

over last year. Haematology and Clinical Pathology have had to remain underdeveloped, and a new department is being organised with professorial status to undertake the bacteriology.

Although the department is now equipped for animal experimental research, routine duties and staff shortage have prevented its development to any useful degree, but in spite of the difficultites, histological and clinical study of some 180 cases of Maduromycosis has been partly completed.

Department of Public Health

(Professorial Chair Vacant)

The department is at present under the direction of the Senior Lecturer, Dr. Anis Mohamed Ali, D.P.H.(Lond.), D.T.M. & H.(Lond.), who has had the invaluable help during the past few months of Dr. Bernard Waddy, D.M., D.P.H., Senior Lecturer, London School of Hygiene and Tropical Medicine, and on loan to Khartoum University from that institution. Dr. Waddy's presence enabled Dr. Anis to spend a full month undertaking a health survey of 2000 school children in the Wadi Halfa area. He will also accompany some 23 students in their field study tour of the Southern Provinces. Reference has already been made to these tour activities of the department, and to its expectation of greatly improved accommodation.

Dr. Anis has this year extended his public health teaching to the 2nd and 3rd year students, in addition to the lectures given to the clinical students during their 4th and 5th years.

Medicine

Professor Hugh V. Morgan, M.A., M.B., B.Ch.(Camb.), F.R.C.P.

It is an inspiration for a surgeon—perhaps especially for a surgeon—to be taken on a ward round by the Professor of Medicine, and the Visitor has rarely spent a more fascinating two hours than he did in the rather shabby isolation ward in the Professor's company. Some of the patients were acutely ill, but many were ' chronics ', though all with expectation of cure. Leprosy, favus, onchocerciasis, vitiligo, D.T. dermatitis, peripheral tuberculosis—these were some of the diseases seen. It is interesting to note the great change in the handling of lepers and their social acceptability which has come about in modern times. It comes as a surprise to those who still think of them in terms of the biblical pattern. Further rounds

were done in the company of Senior Lecturer Dr. A. J. Crowden, and Senior Lecturer Dr. Dawoud Mustafa. The roomy well-appointed and perfectly kept wards accommodated a vast amount of clinical 'material', which appeared to be well utilised for teaching purposes. The small classes (average 5) offer the great advantage of individual teaching. Students become well acquainted with their preceptors, and vice versa.

During the past year a Ministry of Health teaching programme has been re-established in Khartoum Civil Hospital under Dr. Abdel Halim Mohamed and Dr. Mohamed El Hassan Abu Bakr, and the curriculum has been altered so that the student now does a medical clerking appointment in his fourth year and one in his fifth year, instead of two in his fifth year as hitherto. This has added to the amount of ward teaching during the current year.

The arrangement whereby house-physicians now serve only three-monthly appointments has thrown increased burdens upon the senior staff, but this has been lightened by the appointment, for the first time in history apparently, of two registrars to the department.

Research continues and includes the investigation of the causes of splenomegaly; of the pattern of skin disease with special reference to onchocerciasis; and into problems connected with electrolytes following the use of diuretics in the Sudan.

Surgery

Professor Julian Taylor, C.B.E., M.S., F.R.C.S.

The year has seen considerable changes in the pattern of surgery. Following the resignation of Mr. MacGowan as Senior Lecturer there have been two new appointments:—D. J. Crockett, M.B., B.Ch., F.R.C.S., as Senior Lecturer, and J. E. Jacques, F.R.C.S.(E.), as Lecturer. This has infused new life and added breadth to what was already a very live department. Mr. Crockett has had a long experience of plastic surgery and thus this so far neglected but very much needed service is now available in the Sudan. Mr. Jacques has made thoracic surgery his special study and has taken over the thoracic unit started by Mr. MacGowan. The first operation for mitral stenosis in the Sudan was successfully performed by him soon after his arrival and the operation is now becoming established. These surgeons share with the Professor the general surgical duties and the teaching. The department also has a registrar and two house surgeons. In the Visitor's view the outstanding work of the department would be further enhanced both from the standpoint of surgical care and of student instruction by the appointment of a third lecturer who has made orthopaedics his special study. This

opinion is based upon observations made during a tour of Southern Sudan where fracture cases in particular were for the most part inadequately cared for judged by modern standards. This is no reflection upon any of those concerned, who were doing their best with sometimes astonishing success, despite inadequate equipment.

Before Mr. Julian Taylor's appointment to the Chair there had been complaints of paucity of surgical material, and no surgical outpatients had been organised. This situation has now been remedied. The Visitor can testify that the surgical 'material' is now far more abundant than it is in many London teaching hospitals. In one morning out-patient session attended by the Visitor the following cases were among those examined: Lymphogranuloma, bilateral hydroceles, thyrotoxicosis, thyroid adenoma, enlarged prostate with retention, traumatic arthritis, spastic contracture both knees, carcinoma of the breast, fibroadenoma of the breast, inclusion dermoid, recurrent hernia, stone in ureter, disc lesion, lipoma, tuberculous cervical adenitis, urinary bilharzia, Potts paraplegia, anal carcinoma, renal calculus, osteomyelitis, neglected forearm fracture, piles, and recurrent Madura foot. There were in all 27 new cases, and this, it was understood, was an ordinary morning, if anything less well attended than usual because of the fast of Ramadan. The diseases amongst the in-patients naturally corresponded in variety.

Under Mr. Taylor's guidance the fullest advantage is taken of the material in undergraduate instruction. One of the reasons, perhaps *the* reason, why history taking by the students is of such a high standard in this, as in the other clinical departments, is that the student himself, being bilingual, is the interpreter between the Arabic speaking patient and his English speaking chiefs. Without this service it would indeed be impossible for the clinicians to obtain anything but the crudest medical history of their patients.

The lectureship in Anaesthesia is still vacant owing to the failure of appointees to take up duty. The seriousness of this lack of skilled anaesthetists is self-evident, not only as regards patient welfare but also teaching. It is understood that two Sudanese graduates are now undergoing training for higher diplomas in England, so that there is some expectation that the situation may soon improve. There remains, however, an urgent need of secondment of an anaesthetist from England to help to fill the gap.

Reference has already been made to the primary Fellowship Examination so successfully held in Khartoum in January of this year—an historic event.

The investigation into Maduramycosis continues and is being much assisted by Dr. Murray of the Medical Research

Council, who has come for a short stay to study the disease on the spot.

The Department of Obstetrics and Gynaecology

Professor G. L. Daly, M.A., M.D., B.Ch., B.A.O.(Dublin), F.R.C.O.G.

Reference to the excellence of this Department has been made by previous visitors. It enjoys one great advantage not shared by the other clinical departments, of complete integration with the Ministry side of the Civil Hospital, with the Professor as the clinical head. This appears to be an ideal arrangement, and that it works so well may in part be due to the fact that the obstetricians on the Ministerial side are former protégés of the Professor.

Four years ago, because the two years' residence in the U.K. needed to qualify sitting the M.R.C.O.G. imposed too great a strain on the available doctors and on the economy, a Diploma of Obstetrics and Gynaecology of the University of Khartoum (D.G.O.K.) was instituted, and thus far 9 graduates have qualified. Six months training in England is required as a prelude to sitting the examination, which is undertaken at the large obstetric unit of the West Middlesex Hospital under the guidance of Mr. C. W. F. Burnett, M.D., F.R.C.S., F.R.C.O.G.

There are 90 beds in the department, 60 midwifery and 30 gynaecological; and four house surgeons who stay for three months only, a period which in the opinion of the obstetricians is inadequate having regard to the duties the young doctors may have to perform when posted to district hospitals. One of the features of the student training is that, if thought capable, he performs under supervision one or more Caesarian sections.

A pupil midwife school is attached, and the female nursing staff in the department numbers thirteen.

Blood is obtained as elsewhere in the hospital from relatives, as there is as yet no blood transfusion service in the Sudan. Anaemia is a very serious problem, for it is not unusual for an expectant mother whose haemoglobin is about 20% to walk into the department. Babies are on the whole a little below the British average in birth weight, but occasionally 12 and 13 pound infants are delivered. Eclampsia is common, as also is infective hepatitis, which in pregnancy is often fatal. Vesico-vaginal fistula is frequently seen, as it is in most still backward countries, and contrary to widely held impressions, cancer is of frequent occurrence ; three cases of chorionepithelioma have been admitted during the past twelve months, for example.

Arrangements for district work are well organised. Twenty cases are the minimum required for a student, supervised by a midwife. Some of the students ' do ' their district at Omdurman Hospital and some, in part, further afield, such as at Wad Medani and El Obeid.

The Examinations

(*a*) *General*

The Visitor thought the examination was fair both to the candidate and to the repute of the University. The diurnal fasting of Ramadan was in session during the examinations, but it is not known how strictly it was observed by the students, though no doubt some of them may have suffered physically and hence been below their normal competence. There had been a student political strike during the year which used up some of their academic time.

Examining seems to call for a greater degree of patience on the part of the examiners than is the case in England, for the response of the Sudanese candidates tend on the whole to be slower and the hot weather does nothing to promote sustained equanimity in those unaccustomed to it. The examiners, however, showed at all times the greatest consideration, without hint of irritation.

The viva voce questions throughout were invariably clear and to the point, and it was noticeable that if a candidate did not know the answer to a question, he was either given a helpful pointer, or the subject was dropped and a different line exploited.

The organisation of the whole examination was excellent. In the ' clinicals ' the cases were produced without conscious effort and the candidates given adequate time to examine them. Typed copies of the case histories indexed numerically had been prepared for the convenience of the examiners and were available to the Visitor.

The clinical examiners enjoy one notable advantage over their British confréres in that, as the teaching is conducted in English, they are generally able to discuss the nature of the patient's disease and its consequences in his presence without any danger of being understood by him. This is particularly convenient during examinations.

Questions in the pathology medicine and surgery vivas overlapped a great deal one with another, but this is unquestionably an advantage, if only because it helps to break down in the student's mind the idea of compartmentalism, and encourages the concept of holism.

Examining integrity was scrupulously observed by all sections, in that the written answers were assessed by each

examiner quite independently of his colleague, consultation together taking place only after each had awarded his marks.

The examiners, it goes without saying, are senior and experienced and it would be an impertinence for the Visitor to arrogate to himself superior knowledge or wisdom. Indeed he learnt much about viva voce technique and has benefitted accordingly. However, on the assumption that the onlooker sees most of the game and in deference to his terms of reference, these observations are recorded.

(*b*) *Detail*

Anatomy

Professor Butler was assisted by Professor Ruth Bowden of the Royal Free Hospital as External Examiner. The questions in the two three-hour papers were similar to those likely to be set in the corresponding examination of English Universities and were certainly the equal of the latter in introducing into one or two of the questions a clinical bias. The 15 minute viva was shared between the examiners. The test was searching but intelligent, covering the whole of anatomy, and X-rays of the normal were used extensively. Marking was done with commendable precision. The majority of the students during the session attended by the Visitor performed well and it seemed clear that they had an enormous capacity for work, and, on the whole, were endowed with a good memory. Their success, and the whole atmosphere of the examination, confirmed the impression of enlightened teaching previously gained by the Visitor from his talks with the Professor and his inspection of the department. Anatomy in this School at least is not allowed to be "a catalogue of dead things", as Moynihan once called it. Thirty-three candidates presented themselves, three for the second time, and eight failed.

Physiology and Biochemistry

Professor Dean Smith and Dr. Adam were assisted by Professor Cecil Luck of Makerere College, Uganda, as External Examiner. There were two papers, each of five questions, a practical and a viva-voce. The written questions covered a wide field, and it was noticeable that at least half the questions were related to problems of biochemistry, such is the change that has taken place in physiology during the past twenty years or so. The oral examination of 15 minutes was shared between the examiners. The questions were simple and practical, most of them with a clinical bearing, and indicated that physiology is interpreted by the department in its widest sense—elementary metabolism, pulmonary circulation, mechanics of micturition, composition and function of saliva

and the gastric juice, etc. The Visitor thought that the examination was absolutely fair. It was searching and demanded what appeared to him to be a high standard of factual knowledge. Thirty-three sat the examination, three for the second time, and nine failed. The present regulation is that if a candidate fails in either anatomy or physiology he is obliged to take both subjects again and will have an opportunity of so doing in July. As from next year, however, biochemistry will be introduced as a third examination subject and it is understood that a candidate may be allowed to re-sit any one of the three parts separately provided he has passed in the other two.

Of the eight failures in anatomy and nine failures in physiology, five had failed both parts.

Public Health

Dr. Anis Mohamed Ali was assisted by Dr. A. O. Abu Shamma, the Assistant Director of the Sudan Medical Service, as External Examiner. Five questions were set, answers to four of which were required. The questions ranged over a fascinating area of medicine. All of them were essentially practical and emphasized the supreme importance of the organised tours and treks of the students into country districts, both near and far.

Through an oversight on his part the Visitor did not attend the oral part of the examination, which took up one morning only. All the 27 candidates were successful, four with distinction. This happy event bore further witness to the value of the organised tours.

It is understood that the Minister of Health himself stood in at the oral examination for a short time, a circumstance which could not readily be envisaged in Great Britain.

Forensic Medicine and Toxicology

Professor Lynch was assisted by Dr. Mansour El Haseeb, Director of the Stack Research Laboratories, as External Examiner. The single paper, all five questions of which required an answer, was as was to be expected, largely concerned with death in which violence played a prominent part. The 15 minute oral was of a simple nature, and the candidates, quite correctly the Visitor thought, were not required to possess very detailed knowledge. At this Examination as at the viva in pathology (q.v.) the great handicap of inadequate post mortem examination experience was evident.

All the 23 candidates were successful, three gaining distinction.

Pathology and Bacteriology

Professor Lynch was assisted by Professor R. J. Pulvertaft, O.B.E., M.D., F.R.C.P., of the Westminster Hospital, as External Examiner. There were two papers each of five questions, two of which in each case were devoted to bacteriology. Under the latter head was one question on B.C.G. vaccination, one on a virus disease, and one on a protozoal infection. The 15 minutes viva, conducted alternatively by the examiners, was concerned throughout with subjects having a clinical bearing. These 5th year students were noticeably less mature and therefore less confident than the final year students, but this was recognised by the examiners, who dealt with them gently, though not necessarily too leniently.

Many gaps in knowledge were displayed, but considering the breadth of the subject, and the difficulties in staff and material under which the Department labours, this was not surprising. Indeed, having regard to these disabilities the standard was commendable. It is difficult to realise to the full the handicap placed upon education in this subject, as in the smaller subject of Forensic Medicine and Toxicology, by the paucity of postmortem examinations. This was highlighted by the experience of one highly intelligent candidate who recounted how a firm clinical diagnosis had been refuted by a postmortem examination he had been fortunate enough to see. The candidate admitted his disillusionment, but could not conceal his pleasure at the incident. Twenty-one of the 22 candidates passed, none with distinction, though a prize was awarded according to custom to the one adjudged to be the best.

Medicine

Professor Morgan was assisted by Professor G. A. Smart, B.Sc., M.A., F.R.C.P., fo Durham University, as External Examiner. The two papers each of five questions, were designed to test not the factual knowledge of the candidate, but his ability to correlate and interpret details of history and physical signs. They were, indeed, of an exemplary pattern in this respect, and were very appropriately loaded with questions relating to medical problems peculiar to the Sudan.

There is no shortage of physical signs of disease amongst the in-patients of Khartoum Civil Hospital and full advantage was taken of them by the examiners. Many of the 'long' cases seemed to be suffering from more than one major disorder and to the medically untutored eye of the Visitor, demanded a high degree of clinical acumen for their solution. The candidates however appeared to have been trained to face and master complex cases and on the whole did very well. Even the short cases had multiple disorders for the

most part, but the examiners were careful to concentrate only on one aspect of their diseases. The examination was conducted in the friendliest of atmospheres and appeared to be enjoyed by the examiners, by the candidates themselves, and even by some of the patients. The experience of ' listening in ' left no doubt in the mind of the Visitor of the wisdom of training doctors for the Sudan, in the Sudan.

In the twenty minute oral examination an extremely wide field was covered, including indications for surgery, and post-operative after-care. Prospective candidates for distinction were subjected to a particularly searching test. Of the 24 entrants, one of whom had sat the examination previously, four failed. No distinctions were awarded, though a first prize was given.

Surgery

Professor Julian Taylor was assisted by Professor Ian MacAdam, F.R.C.S.E., of Makerere College, Uganda, as External Examiner. There was one paper of five questions which differed from what might have been suited to a qualifiying examination in England only in that one question was devoted to rectal bilharzia. A generous twenty minutes was allowed in the clinical section for a candidate to examine a ' long ' case, upon which he was questioned for fifteen minutes, followed by a further quarter of an hour on ' short ' cases. The clinical material was abundant—46 cases of a varied nature being available. The obvious nervousness of the candidates was soon dissipated by the considerate manner of the examiners and the best was obtained from them as a result. The art of examination technique was indeed delightfully demonstrated.

The candidates appeared to be uniformly proficient in their ability to obtain a relevant history and in eliciting physical signs and it was clear that very special attention had been paid to these fundamental matters during the course of their training as students. Any candidate of exceptional ability was subjected to a very searching test and one of these on his showing that day would have passed the F.R.C.S. England. In some instances a certain weakness was evident in the ability to interpret physical signs but not significantly more so than would be experienced in a similar qualifying examination in England. On the whole no difference could be discerned between the standard expected and achieved between this examination and its equivalent in an English University.

The 15–20 minute oral examination was conducted by each examiner in turn and consisted in a talk over the whole range of surgery, aided by mounted pathological specimens and X-rays as texts. The supply and range of the former seemed to the Visitor to be perhaps a little inadequate, but the

shortage was undoubtedly fully compensated by the great examination experience of the examiners. Far more knowledge was expected from the candidate than in England of the techniques of surgery in view of the responsibilities, without opportunities for reference, which the young graduate may need to shoulder. It was noticeable that emphasis was laid upon a conservative approach to surgical problems.

Twenty-three of the 25 candidates passed, two with distinction, and the prize in surgery was shared.

Obstetrics and Gynaecology

In the absence on sick leave of Professor Daly the examination was conducted by the Lecturer, Dr. J. A. Verzin, with Mr. C. W. F. Burnett, M.D., F.R.C.S., F.R.C.O.G., as External Examiner.

There was one paper of five questions covering both obstetrics and gynaecology, with the major emphasis upon the former. The paper was eminently practical, but the Visitor was informed that the one question which required more than factual knowledge—" Discuss the importance of urine-testing during pregnancy "—evoked answers which fell below the hoped-for standard.

The clinical examination consisted in taking a full history and making an examination of an obstetric or a gynaecological patient (ususally the former), for which thirty minutes was allowed. The knowledge displayed by the candidates of obstetrical problems was, to the Visitor at any rate, most impressive, and provided convincing testimony to the excellent teaching they had received. The overriding importance of the practical as contrasted with the theoretical in obstetrics is well recognised by the examiners in that the maximum mark awarded for the clinical is twice that for the paper.

The oral was shared equally between obstetrics and gynaecology. Each examiner questioned each candidate in one or other of these subjects. In the opinion of the Visitor a high standard was expected and usually attained. Twenty-two of the twenty-five candidates were successful, none with distinction, but a prize was awarded.

One postgraduate student presented himself for the D.G.O.K., and was successful. In Mr. Burnett's view the candidate was fully up to the standard required for the M.R.C.O.G. of England.

Comment

The examiners meeting was presided over by the Dean, and attended in addition to all the examiners, by the Vice-Chancellor of the University, Sayed Nasr el Hag Ali, and the Director of Medical Services, Dr. Ahmed Ali Zaki.

Each subject was discussed in turn, shortcomings aired, criticisms freely made, and finally the Visitor was privileged to offer comment.

It was recorded that of the 25 students who presented themselves, 19 had succeeded in graduating. The Kitchener Prize for the best clinical student of the year was shared by two students. These results were then formally announced to the body of students gathered in the lecture theatre by Professor Dean Smith.

On the evening of March 17th a Degree Ceremony was held in the spacious grounds of the University, with the original Gordon College building in the background, and the successful candidates of the previous session were presented to, and received their scrolls from, His Excellency the Chancellor, Sayed Farik Ibrahim Aboud.

In his address before the presentations Vice-Chancellor Sayed Nasr el Hag Ali thanked the Visitor and the External Examiners and generously acknowledged the contribution this and similar annual visits make to the academic well being of the University of Khartoum.

HAROLD EDWARDS,
Visitor.